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# ELECTRICAL REVIEW

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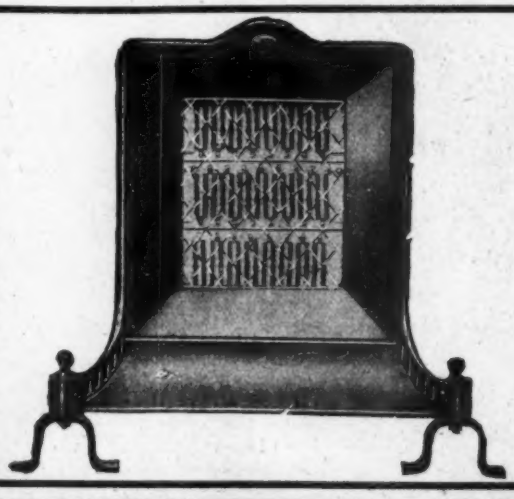

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# ELECTRICAL REVIEW.

VOL. LXXXIV. JANUARY 3, 1919. No. 2,145.

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## TO "ELECTRICAL REVIEW" READERS.

**Owing to the continued increase in the circulation of the ELECTRICAL REVIEW in recent months, an increase which has become accelerated since the signing of the Armistice, we cannot guarantee that casual copies will be available. The only way to make sure of securing a copy regularly as issued, is to place a definite order with a newsagent, or else to subscribe direct to the Publisher, ELECTRICAL REVIEW, 4, Ludgate Hill, London, E.C. 4.**

## 1919—THE NEW ORDER.

WE stand on the threshold of a new era. The war is over, for practical purposes; peace will be restored in a few months, and we look forward to a period of intense activity in the electrical industries. Are we ready for it?

Great changes are in progress in the organisation of some of our principal manufacturing concerns; huge combinations are being formed, with immense capital at their command, which will enable them to deal with the great undertakings which are confidently expected to be launched in the near future; there will be abundance of work to be done both at home and abroad—but other nations will be seeking orders, too, and we must be prepared to meet their competition in the open markets of the world with the three weapons: high quality, low price, and quick delivery. Now, British manufacture is the hall mark of good quality, and we trust that our excellent records of the past in this respect will be maintained and excelled in the future; but low price and quick delivery depend not upon design, workmanship, and material so much as upon efficient organisation—first of the individual workshop, and, secondly, of the whole industry.

The war has taught us many lessons, the gist of which has been impressed upon our memories by arduous effort and prolonged—sometimes painful—experience. One of the most significant of these is the fact that we, as a nation, can do anything that any other nation can do—and do it better—when we realise the necessity of its accomplishment. We have also learnt—what we well knew before, though we did not appreciate it at its true value and importance—that rapid and economical production depends upon quantity production; what we could do when we applied this precept to practice was demonstrated by our astonishing output of munitions of war, a performance which amazed the world. That output was produced, in the first instance, regardless of expense, for the cost was a minor matter, when rapidity of production was a matter of life and death to the nation; but later, when the emergency had passed, our output was also cheapened, in spite of war wages and scarcity of material. But above all, the fact stands out that our factories throughout the land were organised to work co-operatively. Thus we won the war—and we won it largely by efficiency of organisation and collective operation.

Precisely the same principles will govern the result of the industrial conflict which is now about to open. Production in quantity, efficient organisation, and "team work" on the largest scale are the essentials to success in the world-competition that lies before us. *Are we ready?*

The great combines to which we have alluded will be mainly concerned with the manufacture of heavy and costly apparatus, and with the execution of large contracts which can only be successfully handled by concerns equipped with almost limitless resources and personnel; of the necessity for such qualifications, in order to compete with the huge organisations of the United States and Germany, the past history of our electrical industry affords abundant evidence. But it is neither necessary nor desirable that smaller firms should endeavour to emulate the example of their big brothers, and to make "everything electrical"; nor is it necessary that the big concerns should trouble themselves with the production of apparatus that are manufactured on a repetition basis, and can therefore be turned out in quantity by the smaller ones with equal economy and efficiency. Let us not forget the lessons of the war.

For 20 years, like a voice crying in the wilderness, we have urged our manufacturers to co-operate—to collaborate

—to lay aside petty jealousies and help one another—in a word, to *organise* the industry, which means in a large measure to specialise; four years of war have but confirmed the wisdom of our preaching—but do we see any symptoms of real conversion amongst our manufacturing friends? We gravely fear that Peace is bringing with it but a renewal of the old individualism which, whatever its merits in the past, *will not serve in the future*. It is not yet too late to mend our ways; now, indeed, is the very time, whilst we are changing over to peace production, when our industries could be most easily organised for victory in the trade war. We are not speaking merely to the great combines, but to the smaller firms also—to those who, having built up thriving businesses in certain lines, cling to them with the just pride and affection of the creator. It is, perhaps, at once the pride and the misfortune of the electrical industry that it is as yet so young that the originators of designs which have attained high reputation still retain personal control over their creations, and carry on their businesses rather as a hobby than as a source of revenue. But the interests of the nation should prevail over the inclinations of the individual, and it is the patriotic duty of every man to ask himself whether by sinking his individuality to some extent he can promote the national welfare. We repeat, in conclusion, that organisation and specialisation on the part of electrical manufacturers is the key to success in the trade war—and we see no evidence as yet that that key is going to be used.

**Sheffield's War Activities.**

In presenting to our readers to-day an account of the electrical developments in Sheffield during the war, we may with advantage draw attention to the splendid record of the city as one of the principal factors in winning the war. Of the world-wide reputation of Sheffield as one of our most important steel-producing centres, we need not speak; the city was also noted for its manufactured products based on steel as the raw material, and for its electro-plated goods. During the war the industries of the city underwent a complete transformation, and it became a huge manufactory of munitions, employing over 120,000 workers on this class of production, of whom some 30,000 were new to the life of the workshop. The output of the city was doubled, and the railway traffic during the year ending June last was 35,000,000 tons. Innumerable new works were built and existing works extended on a large scale, new steel furnaces were started, and electric steel furnaces to the number of about 60 were constructed. The great steel firms were reorganised and brought together, and combinations were formed to secure control of all the raw materials necessary to the increase of output and to the cheapening of production. Since the armistice unemployment has not overtaken the industrial population; on the contrary, the city is up to the neck in work, with orders in hand for many months to come. Sheffield, in fact, not only played a leading part in the war, but is going to do so also in peace time, and may be depended upon to hold her own with all comers.

The phenomenal progress of the electricity supply department, under the management of Mr. S. E. Fedden, has already been commented on in these columns; between 1914 and 1918 the revenue increased five times and the output seven times, the capital expenditure was doubled and the net profit increased ten times. When the present and prospective extensions have been completed, the plant capacity will have been increased from 23,000 KW. in 1914 to 146,000 KW., making it one of the four largest undertakings in the Kingdom.

In the face of these striking advances in the industrial fortunes of Sheffield, it is interesting to reflect that the city contains hundreds of small manufacturing firms, each in pre-war times confining its attention to a very restricted range of products, and that an intensely conservative spirit reigned in the community. The fact that changes so vital and fundamental have been effected in so short a time is striking evidence of the inherent adaptability and capacity of the British character, and augurs well for the future of the country in the difficult times that lie ahead.

Sheffield first became a steel centre because of its many small water powers, which provided the necessary power to forge swords and bayonets; gradually extending its scope, the city began to make steel for itself, and then to manufacture from its steel many other products besides military weapons. It is curious to observe how by a return to its primitive occupation the spirit of the city has been revivified and its energies have been aroused. Well has Sheffield "done its bit!" May its prosperity never wane.

**Our Consuls and Trade Development.**

DISCUSSION has been renewed in the Press on the question of the qualifications of British Consuls. The Government Department concerned with these appointments did not feel able to fill the offices while so many excellent men were away with the Forces. Now that specially required men are being released, we presume there need be no further delay; certainly few things in connection with trade are of greater importance now that the war is ended. We observe that special plans are on foot for ensuring that men selected for such posts shall have suitable experience in touch with our industries, and the business world will be eager to know the details, so that they may judge the likelihood of their being able to rely upon, and co-operate with, the new officials in making their efforts for British trade expansion throughout the world. In the course of speeches that have been delivered lately by critics of the past Consular Service, one speaker mentions Consuls whom he has known who had no knowledge of the weights and measures of the country to which they were sent; another instances Consular appointments in Russia given to men who knew nothing of the Russian language. No doubt the Government, which is pledged to establish the Consular Service upon a new basis which will ensure its efficiency, will see that these, and the many other defects of the past, are not continued. From what we can gather, there is no probability of any undue haste being shown in connection with this important matter. To secure that a sufficient number of adequately trained men of the right type are available at their appointed posts will necessarily take some time, but we hope that those responsible will not let the grass grow under their feet. We ought soon to be having a series of official reports from the different markets if the business world is to be adequately assisted in strengthening our export trade connections, but manufacturers will be unwise if they fail to make very energetic efforts on their own behalf. They will not need much official assistance in reviving connections which, unfortunately, have in too many cases been allowed to lapse under war conditions. No doubt they are using the foreign postal service pretty freely just now, and are arranging tours for their travelling representatives, as well as preparing printed literature regarding their manufactures for the use of their agents on the spot and for sending direct to likely purchasers. Happily trade organs which have maintained their efficiency against great odds during the past four years have been available for Colonial and foreign trade publicity right along, and during the coming months, before Consuls or foreign representatives can be at their posts, or new catalogues and publicity literature can be ready, these organs will fill more actively than ever before the *rôle* of business-getter. They are sometimes criticised by those who have an axe of their own to grind or who are incapable of understanding other people's war-time difficulties and who imagine that the paper situation has been equally serious in all countries. But we believe that speaking generally the British manufacturer and trader will make the fullest possible use of all tried available facilities in these days when thousands of potential purchasers abroad want to know what we are going to do out of our increased productive capacity to help to satisfy their crying needs.

We observe that the British Trade Commissioner who has completed a tour of Eastern Ontario finds strong sentiments in favour of British goods, but he points to a lack of British publicity effort such as is necessary if we are to face the aggressive selling methods which may be expected to characterise the foreign competition that is coming.

# ELECTRICITY SUPPLY IN SHEFFIELD.

We have on previous occasions recorded the progress of the electricity supply department of the Corporation of Sheffield,* and have pointed out the vast scope for the development of this branch of the Corporation's activities that was afforded by the great industries of the rapidly-growing city; but no one, we should think, could ever have foreseen the extraordinary increase in the importance of the department which has taken place during the war. In 1912, when we last described the works of the undertaking, the output was under 17 million units per annum; in the year ending March 25th, 1918, it was no less than 172½ millions—an increase of over 900 per cent. Up to the outbreak of war, the progress of the undertaking was normal and steady, the output for the year ending March, 1914, being 26½ million units; during the war, therefore, the output has increased by nearly seven times, while the annual income has reached the amount of £639,667, the balance of profit alone being larger than the total revenue in 1914. Naturally, this rapid expansion has not been accomplished without imposing a vast amount of work upon the staff, and it is interesting to observe that the whole of the extensions of plant and mains have been carried out "according to plan" by the department, on the lines laid down by the general manager and engineer, Mr. S. E. Fedden, M.Inst.C.E., as long ago as 1904. This could not have been accomplished without effective organisation; but, fortunately, Mr. Fedden had so organised the undertaking, and so trained his staff, that when war broke out, and the demand began to advance by leaps and bounds, all that was necessary was to carry out the plan of campaign already outlined, each head of a department being in a position to perform his own section of the work under the general supervision of the chief. In a word, the organisation of the whole undertaking was such that it was capable of expansion even to ten times its pre-war capacity without a hitch—provided that the necessary plant could be obtained at short notice.

At the outbreak of war in August, 1914, the department was preparing to meet the normal increased output, and a new 8,500-kw. turbo-alternator was in course of erection at Neepsend, while the contracts for building extensions and the installation of the necessary boilers and auxiliary works were in progress. The first effect of the declaration of war was a heavy drop in the demand for electric power; the output fell off by one-third of the normal demand during the first week and one-fourth during the second, but in the third week the normal output was regained, and from that time onwards rapid and continuous progress was made. Applications for supply began to pour in at an unprecedented rate, and it soon became evident that additional plant would be required to cope with the growing demand. The installation of the plant above mentioned was pushed on as quickly as possible; but owing to the dislocation caused by the mobilisation of the Army, and the resulting difficulties in obtaining materials, it was not until March, 1915, that the new set was able to run on load. In the meantime, in November, 1914, preparations were made to install a second 8,500-kw. set, with the corresponding boiler plant, to meet the 1916 demand, and orders were placed for the necessary plant.

To add to the difficulties of the situation, two of the largest generating sets at Neepsend broke down just before Christmas, 1914, when the heaviest load of the year fell due. Continuity of supply was interrupted only for a few

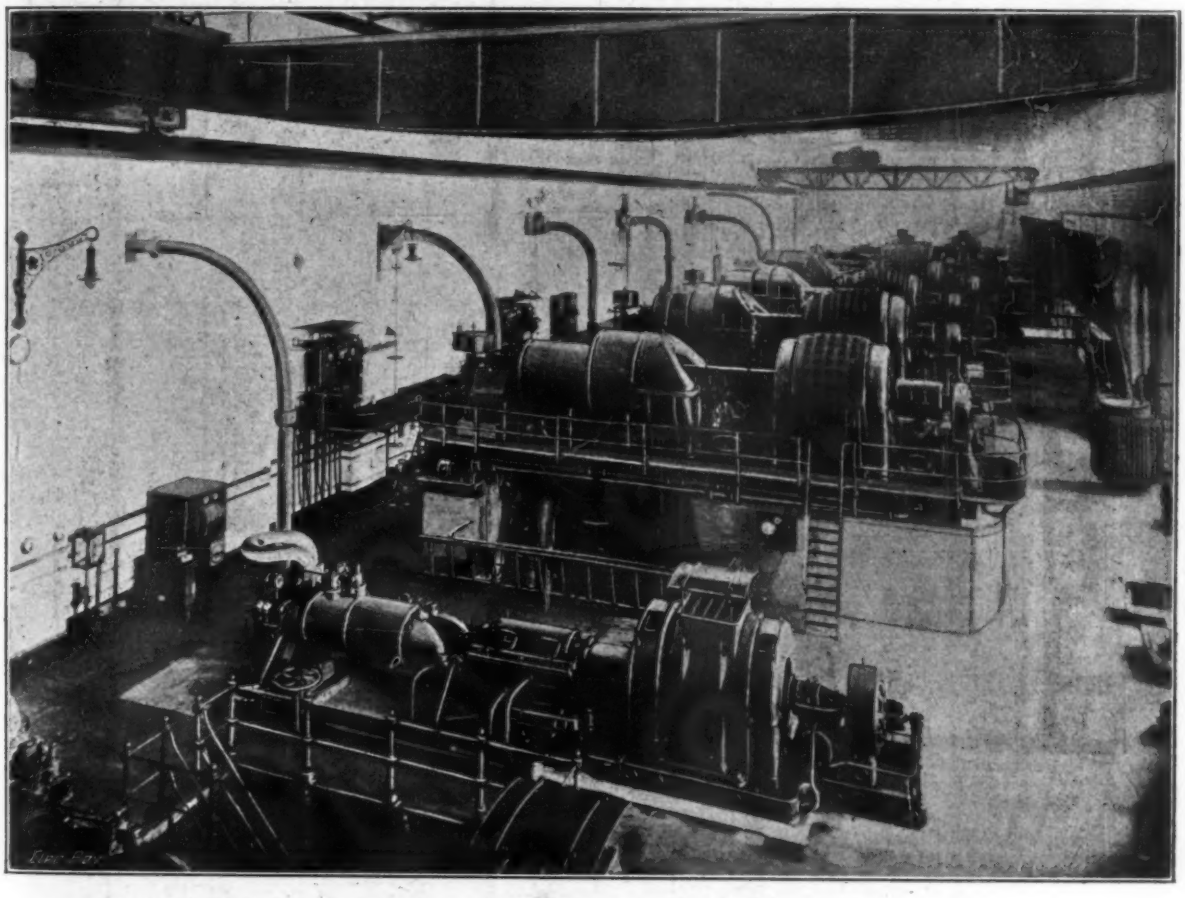

Fig. 1.—Neepsend Power Station: Interior of Turbine Room.

* Electrical Review, July 15th, 1904, and August 30th and September 6th, 1912.

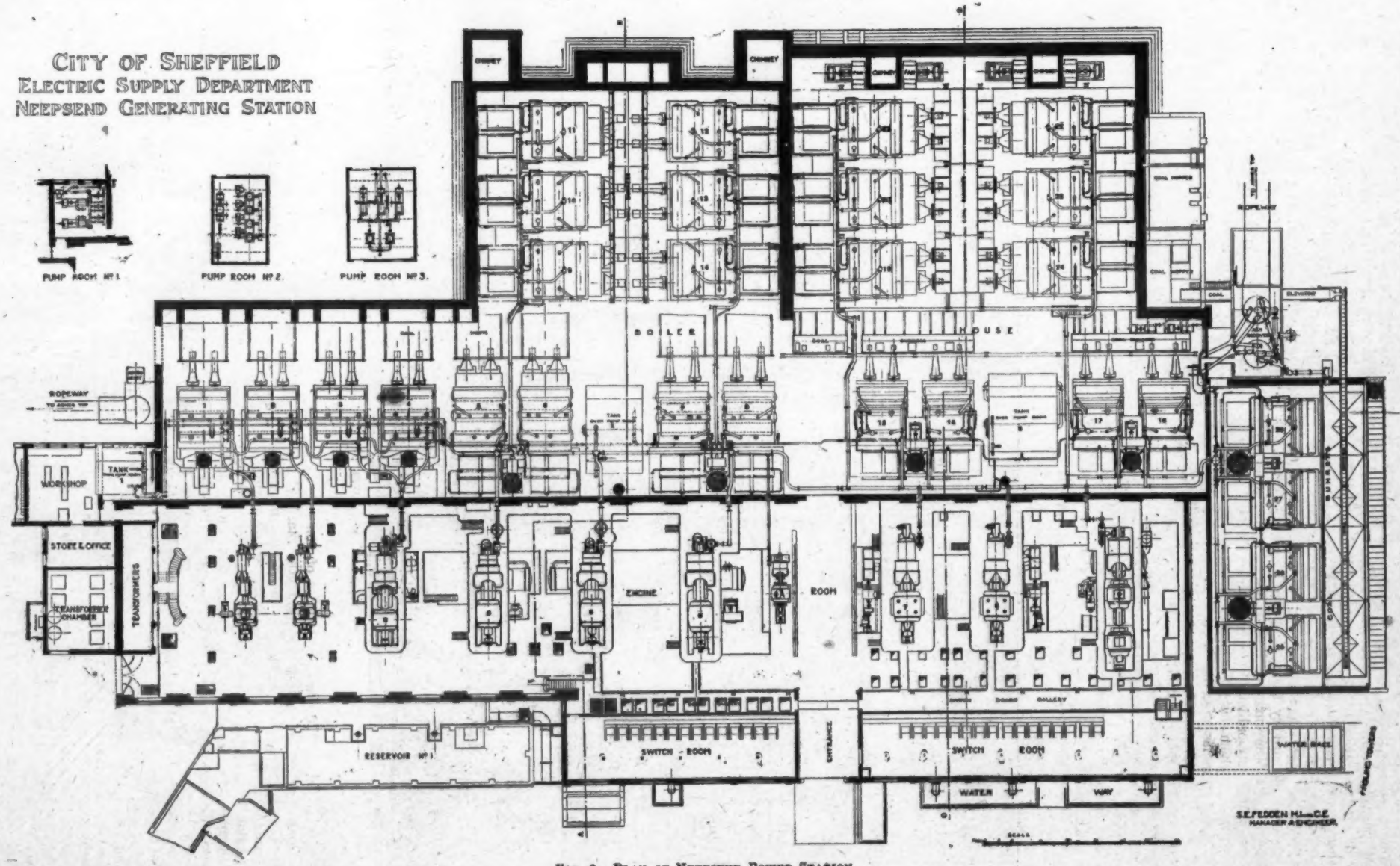


FIG. 2.—PLAN OF NEEPSEND POWER STATION.

minutes, and by bringing into use the whole of the available plant in all three generating stations, the general supply of the city was fully maintained; much of the plant had been lying idle for years, but it had been maintained in excellent condition, so that it could be brought into use at a moment's notice. The rush of applications for electricity supply continued, and in June, 1915, it became necessary either to decline further applications, or to install additional generating plant immediately. A 2,000-KW. turbo-alternator, intended for a Russian colliery, which was practically ready at the maker's works, was commandeered by the Ministry of Munitions, and afforded temporary relief, but this was obviously inadequate to cope with the increased demand, and steps were taken to ascertain what

train of about 40 trucks of coal broke a coupling and ran the full length of the siding, crashing into the steel framework of the new boiler house; this accident entailed a delay of six weeks in repairing the damage done to the steel work.

The load on the station continued to increase, and new applications to pour in, and it was seen that even with the new plant then on order the capacity of the stations would be unequal to the demand, so at the beginning of January, 1916, orders were placed for another 8,500-KW. turbo-alternator and the corresponding boilers, at an estimated cost of £137,000, which was raised by the Ministry of Munitions for the purpose. At this time the existing plant was working continuously on overload to cope with the demand; no time was available for overhauling and

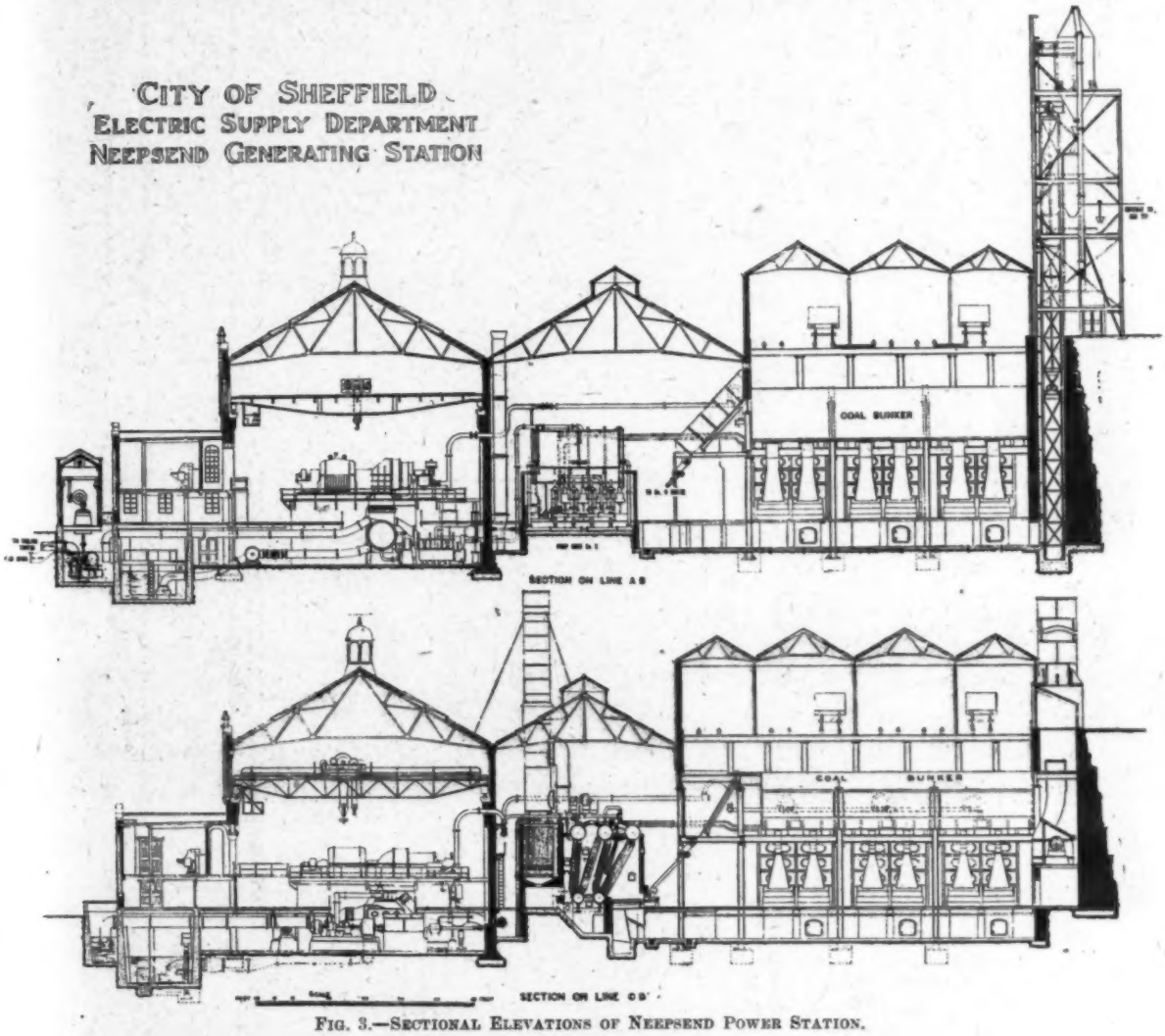


Fig. 3.—Sectional Elevations of Neepsend Power Station.

Fig. 2.—Plan of Neepsend Power Station.

further plant was obtainable; it was found that a 9,000-KW. set was in course of construction for a South American railway, and this also was commandeered by the Ministry, which also provided the capital required to pay for this set and the additional boilers and other apparatus necessary to its operation. At the same time the buildings were being extended to practically double the size of the existing station, as rapidly as possible, the work being carried on without cessation. Large arc lamps were used to illuminate the site at night, in spite of the lighting restrictions then in force, and in frosty weather coke fires were lighted every few yards near all concrete and brickwork, to prevent delay in the work. The large extensions in progress necessitated the handling of heavy structural steelwork at great heights, and the interworking of cranes, light railways, and moving machinery in an area congested by the working gangs of some 20 contracting firms, but no serious accidents occurred to life or property, except one on the railway siding, when a

inspecting the plant, and it was not surprising that in March two generating sets broke down, necessitating the restriction of supply to certain large consumers to night work whilst repairs were in progress. The strain on the staff during these trying times may be imagined; but everyone loyally worked "all out" to overcome all difficulties and to maintain continuity of supply in face of the ever-mounting demand of the City's munition factories. The rate of progress is well illustrated by the following table:—

| 12 months ended March 25th— | 1914. | 1915. | 1916. | 1917. | 1918. |
|---|---|---|---|---|---|
| Capacity of plant .. | 23,225 | 31,725 | 42,225 | 59,725 | 68,225 |
| Units sold .. .. | 26,546,718 | 44,873,342 | 77,868,027 | 126,476 858 | 173,451,007 |
| Coal consumed, tons | 44,187 | 70,511 | 131,123 | 194,101 | 244,342 |
| Cost of coal .. | £17,830 | £35,005 | £85,437 | £146,056 | £238,777 |

The relative positions of the four generating stations belonging to the Sheffield Corporation are indicated on the accompanying sketch-plan (fig. 4); it will be seen that the original station at Sheaf Street, and the tramway power station

at Kelham Island, are situated at the centre of the city, but when the necessity of erecting a large installation became evident, it was decided to make use of the natural advantages of the site at Neepsend, on the north-west of the city,

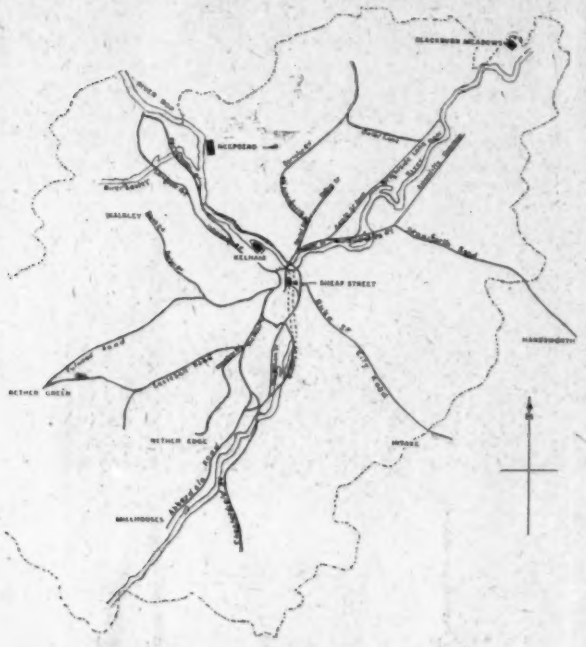


FIG 4.—PLAN OF SHEFFIELD, SHOWING POSITIONS OF GENERATING STATIONS.

and about two miles from the central area. It was then anticipated that the future industrial load, which was confidently expected, would develop in that direction; as it turned out, the demand for power and heating arose chiefly in the north-east, and it is in that quarter that the new station is being erected at Blackburn Meadows. The distance of transmission from Neepsend, however, is not great—about 3½ miles to the industrial area—and the excellent facilities afforded by the site for the supply of water and coal, and the disposal of ashes, amply compensate for this slight drawback. The station is built close to the river Don, on the flank of a hill, which enables the trains of coal trucks to be run in above the boilers, thus dispensing with costly machinery and labour for handling the coal. Ample space is available in the adjoining valleys for dumping ashes, and a large yard is provided for storing coal. The station is built on rock foundations; the clay excavated from the site, being of excellent quality, was made into bricks on the spot, and utilised for building the station.

The lay-out of the buildings is shown on the accompanying plan (fig. 2); it will be noticed that in the first instance the boilers were arranged alongside of the turbine room, and this arrangement was satisfactory so long as the generating sets were of comparatively small output, but the installation of larger sets in the newer part of the station necessitated the provision of additional boiler houses teed off from the main range, and in the completed station the steam-raising plant covers a far larger area than the turbine room. The latter consists of one long room divided near the centre by a passage extending also through the boiler house, and the whole of the plant and switchgear is so laid out that the building and its contents can readily be divided into two independent stations, in order to afford protection against breakdown which might otherwise affect the whole of the plant. At present, however, the station is run *en bloc*.

The power-station building, in its completed form, covers an area of about 2½ acres; the turbine room is 384 ft. in length and 76 ft. wide; and the boiler houses, as shown in the plan of the station, are arranged along one side and one end of the engine room. The great length of the building is, perhaps, best illustrated by our view of the exterior (fig. 5), which also shows the eight cooling towers at the south end of the site, and the ash heaps beyond the station towards the north and east. Adjoining the main buildings are the pump room for the cooling towers, stores, mess rooms, &c. At the south end of the site, behind the cooling towers, the hill-side has been levelled and made into a yard for storing coal in the open; this is served by a self-propelling steam crane, which stacks the coal with the aid of a two-ton grab, and also delivers it to the hoppers when required (a second crane is about to be provided). Our illustration (fig. 6) shows part of the coal yard and the

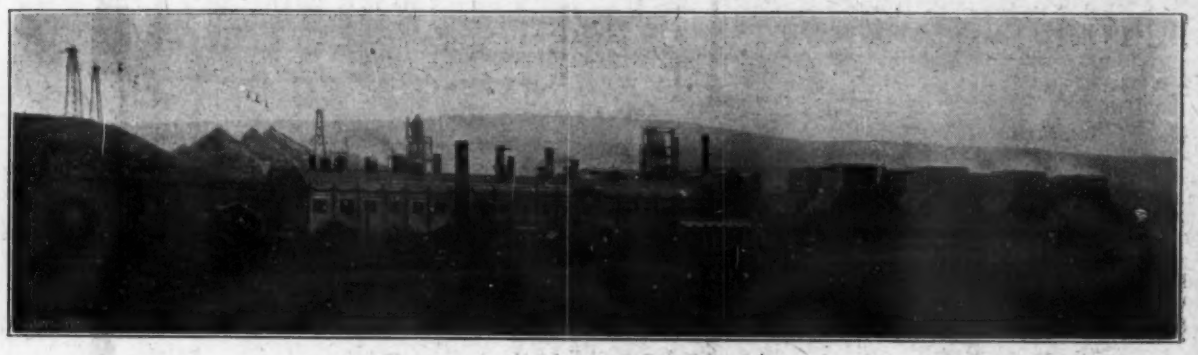

FIG. 5.—EXTERIOR OF NEEPSEND POWER STATION.

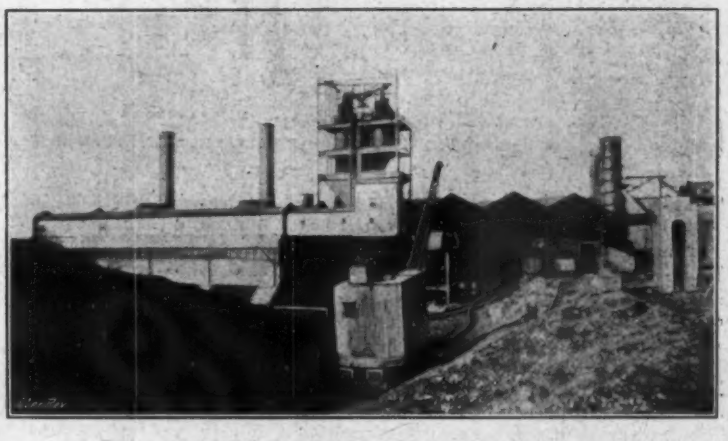

FIG. 6.—SOUTH END OF POWER STATION, AND COAL YARD.

crane, together with the end of the station buildings and of the covered sidings and coal bunkers. The sidings are fed by a branch from the Great Central Railway, and provide ample accommodation for storing full and empty trucks, which are handled by means of nine reversible capstans, each driven by an 18-H.P. motor; the coal is weighed in

the trucks on a weigh-bridge before entering the coal store, and is measured into the hoppers of the mechanical stokers. Normally four or five train-loads arrive at the station daily, and are dumped either into the bunkers through iron gratings, which prevent large pieces of coal from passing to the shoots, or into the hoppers which feed most of the boilers directly. In order to handle the trucks across the five tracks, two traversers, each driven by a 9-H.P. motor, are provided; each traverser is equipped with a capstan driven by the same motor and capable of hauling in either direction, and traverses the coal shed from one side to the other. The trucks are hauled up ramps on to the traverser, and the control is so arranged that it is impossible to carry out any operation in the wrong way. No accident has ever happened in connection with these traversers, although they are used by unskilled labour, male or female, and they have given great satisfaction. They were made by Messrs. Ransomes & Rapier, of Ipswich, and one of them is illustrated in fig. 9.

The hoppers are arranged as shown in the plan and sectional elevations, from which it will be seen that the coal is delivered from the railway trucks to the stokers without any handling; from the hoppers it passes into measuring chambers and through breeches pipes to the stoker hoppers, and the operation of the coal valves automatically records the quantity of coal fed to the grates, by volume; the record is found to agree closely with the measured weight. The bunkers of the first eight boilers had inclined floors, so that they could be completely emptied by gravity; in the later extensions the bunkers were made rectangular in vertical section, to increase their capacity, the coal being trimmed into the shoots when the stock is low. The coal stored in the main bunkers is similarly trimmed by hand when it is necessary to draw upon the reserve. The last extension of the boiler house is situated at a higher level,

Fig. 8.—Ropeways and Ash Tips.

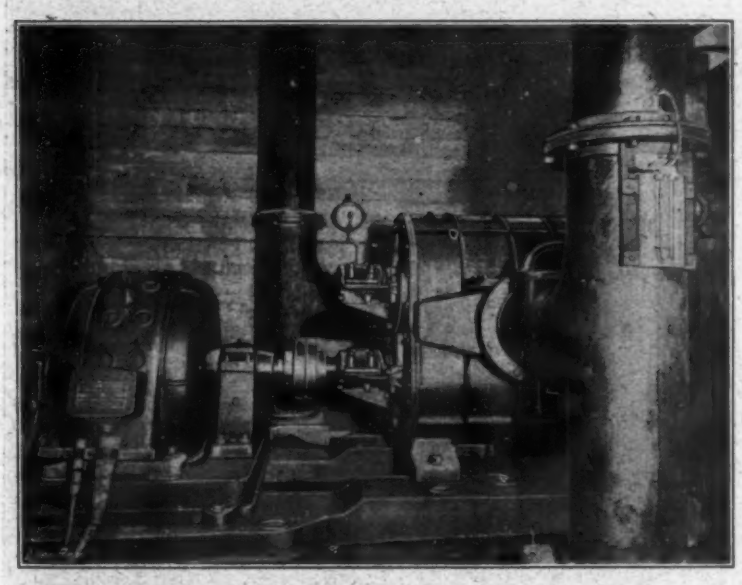

Fig. 7.—Roots Blower for Ash-handling Plant.

across the end of the turbine house, and to supply it with coal an elevator has been installed, together with a tray conveyor running the length of this boiler house; the housing of this conveyor, which was supplied by Messrs. Babcock & Wilcox, is seen in fig. 6.

To remove the ashes from the basement of the boiler houses, a hand-operated tramway is provided, and the loaded trucks are pushed on to a lift which elevates them to a hopper, into which the ashes are tipped; after the truck has been put on the lift and locked in position, the whole of the operation is automatic, until the empty truck is returned. A pneumatic ash suction plant has also been installed, which carries off the ashes and discharges them into receivers above the ash hoppers; the air is exhausted by Roots blowers, one of which is shown in fig. 7; the blower is driven by a motor, and gives a suction of 4-in. to 5-in. water gauge. The air is drawn from the top of the receiver, while the ashes are delivered into the latter below a water spray, which damps down the dust; an air washer is provided in the suction pipe. The Roots blower is capable of handling 20 tons of ashes per hour. There are two sets of blowers and ash receivers; one set has two receivers, either of which can be brought into use, and the system is so arranged that a duplicate service is provided for all parts of the boiler house. The pneumatic system is in regular use, the tramway being held in reserve.

From the receiver the ashes fall into the same hopper as the ash trucks discharge into, and thence they are fed into skips on aerial rope-ways, made by Messrs. R. White and Sons, of Widnes, which were fully described in our issue of April 9th, 1915. There are in all three of these rope-ways, leaving the station at either end and at the middle of its length; in the later installations the operation of the rope-way is largely automatic, the loaded skips being pushed on to an inclined railway, down which they gravitate to the cable-way, automatically gripping the hauling rope, which carries them out to the dumping ground. After depositing their loads at a spot where the tripping gear is fixed, they return to the station, and are automatically freed from the hauling rope.

The system of aerial rope-ways is a striking feature of the landscape at the rear of the station buildings; still more remarkable are the veritable mountains of ash which have already been built up in the adjoining valleys, and which can be seen in figs. 5 and 8. When it is borne in mind that the coal from which the ash was derived must have occupied a bulk from 6 to 10 times that of the ash, some idea can be formed of the immense quantities of fuel that are consumed by a large power station.

Two of the rope-ways leave the east side of the building and cross the Great Central Railway over safety bridges; one of them is the most intricate of its kind in existence, at one point turning an angle of 140°. These rope-ways can each handle 20 tons per hour. The third leaves the north end of the station, and can deal with 10 tons per hour. In some places the tip is already 100 ft. deep by ¼ mile long. The tipping ground covers an area of 40 acres.

An 18-in. culvert has been provided at the bottom of the valley to drain the land, and manholes in connection therewith are being carried up to the top of the tip, 140 ft. from the soil. Test shafts are provided in the mass of the ash heaps, being built up as the deposit grows, to enable the temperature of the dump to be measured.

D

The tipping is regulated so that eventually the whole of the area will be uniformly filled, and the surface will be levelled by explosives, or otherwise, when that stage is reached. The light iron towers which carry the rope-ways are, of course, gradually buried under the pile.

Make-up water for the boiler feed is derived from the town mains, and is of a very soft quality, the total hardness being 1 to 2°. Make-up water for the cooling towers is obtained from the River Don, and averages about 12° of hardness. In the winter months sufficient cooling water is derived from the Don without the use of cooling towers. The large quantities of water dealt with give considerable importance to the equipment provided for this purpose. The intake from the river is close to the north end of the power-station buildings; the main channel is 14 ft. wide, and the depth of water is 9 ft. Nearer the station the channel is 20 ft. wide, and the water passes first through raking screens, which stop the larger leaves, twigs, &c., and afterwards through a revolving disk screen, made by Messrs. F. W. Brackett & Co., Ltd., of Colchester. In addition, there is a Brackett duplex revolving band screen for use at times of flood. From the cleaning apparatus the water passes into a large reservoir, 20 ft. wide and 18 ft. 6 in. deep, running the whole length of the building beneath the switch rooms, and divided into three sections, which can be shut off from one another by sluice gates. No. 1 section is nearest the river; No. 2 is provided with a by-pass from the river—a 3-ft. pipe, which derives a supply from a separate inlet, through a leaf comb, by Messrs. Whitehead & Poole, of Radcliffe, and a Brackett revolving band screen. The third section is at present without separate connection with the river. Sediment rapidly accumulates in the reservoir (which is primarily a settling tank), and therefore it is necessary to lay off the sections in turns, on Sundays, to clean them out. A weir crosses the river below the intake, and trouble was experienced through the bed of the river silting up, but this was overcome by providing a sluice gate; this is opened at flood time, and the resulting current effectually scours the basin.

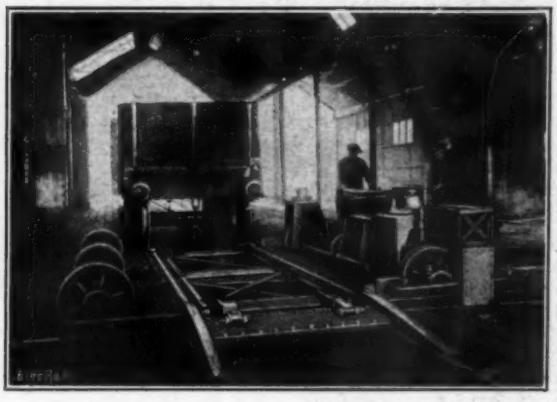

Fig. 9.—Electric Traverser.

The far end of the reservoir receives the cooled water from the towers, which forms a torrent of imposing dimensions when the station is working at full load in the summer, twice as much water passing over the towers as is consumed in the whole of Sheffield in the same time.

The hot water from the condensers is discharged into channels which run alongside of the building, the pipes being carried down beneath the water surface to secure the benefit of the siphon action. From these channels the four pumps derive their supply; they are situated in a roomy building at a level below that of the channels, so that they are self-priming, and are of the Worthington centrifugal type, each capable of lifting 660,000 gallons per hour; they are driven by two Crompton and two Fuller motors of 250 H.P. each, controlled by Reyrolle switchgear and liquid starters. The interior of the pump room is shown in fig. 10.

The cooling towers were built by Messrs. Bradshaw and Co., of Manchester, after the outbreak of war; seven of them are capable of dealing with 330,000 gallons per hour each, while the eighth is rated at 375,000 gallons. Each pump serves two of the towers. The average amount of cooling is about 18° F., and the loss of water by evaporation is not more than 2 per cent. The circulating water is periodically changed by discharging it from the cooling towers to the river through a 4-ft. pipe.

In addition to the four pumps above-mentioned, there was provided in connection with the earlier section of the power station a Worthington pump rated at 770,000 gallons per hour, which is driven by a Lancashire Dynamo Co.'s motor with vertical shaft.

The boilers are all of the Stirling five-drum type, with internal superheaters and (with the exception of the first four) Green economisers; they are of four sizes—Nos. 1—4, 32,000 lb. per hour; Nos. 5—8, 38,000 lb.; Nos. 9—14, 40,000 lb., and Nos. 15-28, 50,000 lb., from and at 212° F. As shown by the plan on page 4, they are divided into three groups, Nos. 1 to 14 forming No. 1 boiler house and No. 1 extension, Nos. 15 to 24 No. 2 boiler house and extension, and the remainder No. 3 boiler house. Thirteen boilers are fitted with underfeed stokers, and 15 with chain-grate stokers; and all the boilers work with induced draught, the waste gases

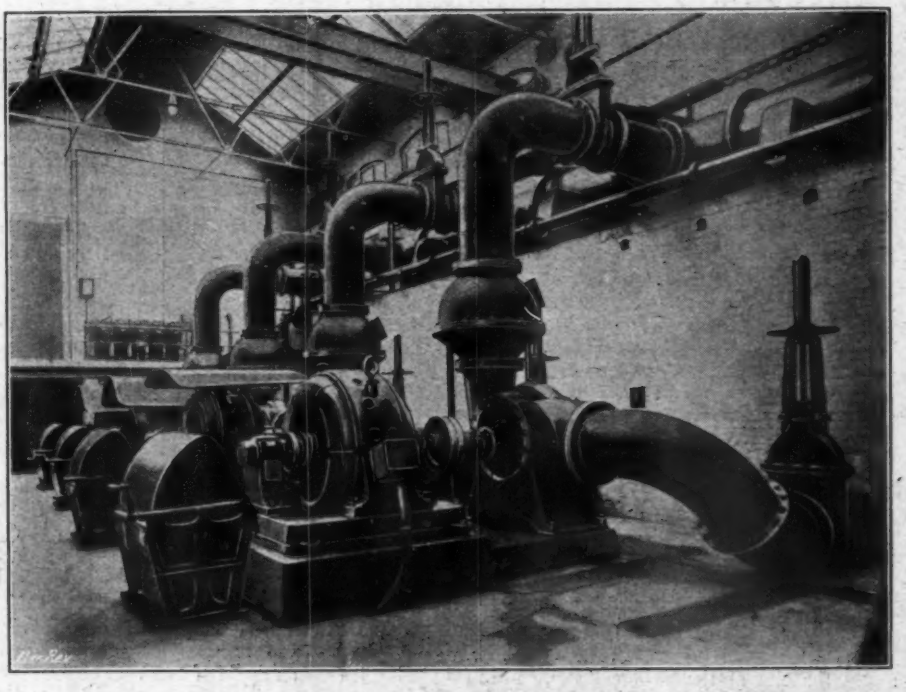

Fig. 10.—Pump Room for Cooling Towers.

being discharged into steel chimneys. Steam is generated at 200 lb. per sq. in., and superheated about 150° F., the temperature at the stop valves being about 540° F.

The fans are in duplicate, two to each chimney; either suffices for three boilers on light load, or two on overload.

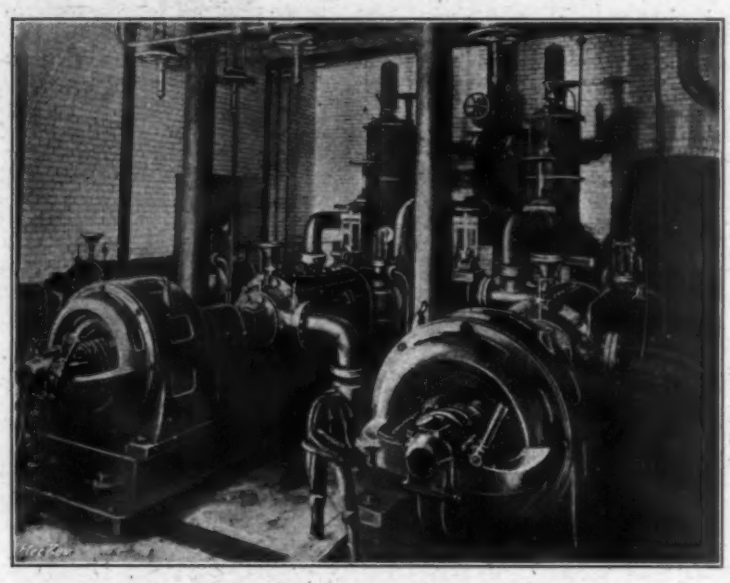

FIG. 11.—INTERIOR OF NO. 3 PUMP ROOM.

They are of the "Sirocco" type, made by Messrs. Davidson and Son, Ltd., of Belfast. The induced draught is maintained at about $\frac{3}{4}$ in. water gauge at the back bank of tubes; the pressure of the forced draught on the underfed furnaces is 2 in.

provided by the Stirling Boiler Co., Ltd., and Messrs. John Spencer, Ltd. The pipes are mainly of riveted steel.

Feed water is supplied by four pump rooms; No. 1 pump room, at the north end, contains one Hall steam-driven pump, capable of delivering 10,000 gallons per hour, and two motor-driven turbine pumps, made by the British Electric Plant Co., Ltd., each capable of supplying 20,000 gallons per hour. No. 2 room is near the middle of the boiler house, and contains four Hall steam pumps and one B.E.P. pump. No. 3 is in No. 2 boiler house, and contains three B.E.P. pumps; and No. 4 pump room, at the south end of the station, contains two B.E.P. pumps. We give a view of No. 3 pump room (fig. 11), which is a pattern of orderly arrangement and accessibility. Duplicate feed piping is provided, direct to the boilers and through the economisers, with a by-pass round the latter. The southern section of the station, with its boilers, pumps, &c., can be run as a separate station, entirely independent of the rest of the plant. The turbine pumps are driven by two-phase motors of 100 H.P. each.

The working of the boiler house and condensing plant at Neepsend is of exceptional interest, as every effort is exerted to secure and maintain the highest possible efficiency and economy. A strict watch is kept over every item in the boiler house. Every week the stock of coal in hand is checked, and samples of the coal are taken daily, samples of the ashes every watch; the works chemist has a well-equipped laboratory under the switch rooms, and carries out complete tests of the calorific value and composition

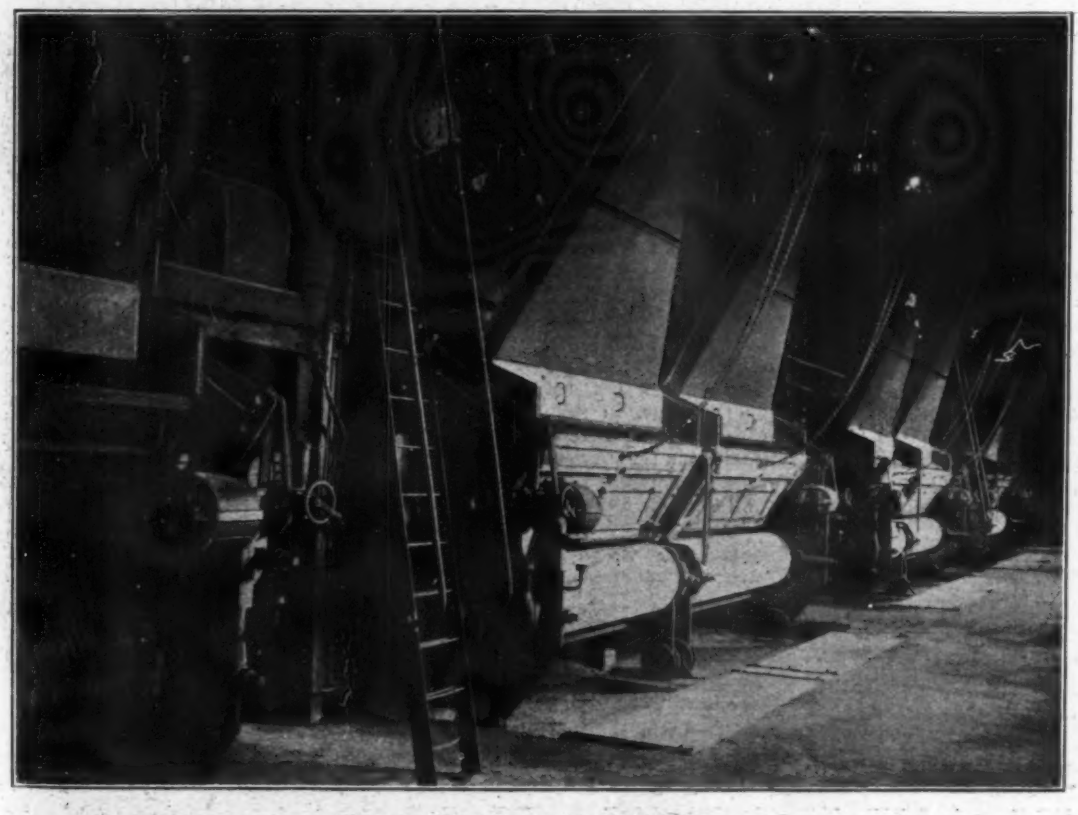

FIG. 12.—NO. 3 BOILER HOUSE, NEEPSEND.

The whole of the boilers are connected to a main steam header 12 in. in diameter, but can be divided into two sections, if desired. The chief contractors for the pipe work were Messrs. Aiton & Co., Ltd., of Derby; portions were

of the coal and ashes from each boiler house; each foreman stoker is held personally responsible for keeping his results up to the standard level. The temperatures of the feed water and flue gases at both ends of the economisers and in

the uptakes, the temperatures of the furnaces, and of the circulating water entering and leaving the towers, &c., are all recorded, and the flue gases are analysed daily. Samples of the boiler, feed water and the circulating water are taken and analysed daily, and the draught-gauge readings are recorded.

The economisers are fitted with National circulators, and a by-pass is provided from the hot to the cool end, to ensure that the water at the cool end shall never be below 120° F.; live-steam heating is also provided for the same purpose. All the boilers from No. 1 to No. 14 are fitted with Venturi meters; the latter could not be obtained during the war for the boilers installed later. Ten of the new boilers are fitted with feed regulators supplied by the Crosby Feed Regulator Co., which are said to have proved very reliable and efficient.

A weighing machine is provided in the boiler house for accurate fuel-consumption tests.

Practically a continuous "heat balance" is maintained, and for 12 months past the efficiency of the steam-raising plant has been kept above 70 per cent. all the time.

The condenser leakage is tested three times a day; for this operation the Dionic tester is to be adopted.

Each turbo-generator is provided with a Lea recorder and an indicating wattmeter, so that a consumption test can be taken literally at any moment. Several times, by means of this continuous test, incipient trouble in the turbines has been detected, and prevented from developing into a serious fault. The average consumption of the whole station is 15 or 16 lb. of water per KW.-hour generated.

Besides the foregoing tests, the laboratory is equipped for testing fire bricks and other refractories, the flash point and viscosity of oil, &c.

The running data, coal and steam consumption, &c., are worked out daily, and are reported to the station superintendent and the general manager the first thing in the morning, and if any departure from the normal high standard of efficiency is noted, an immediate investigation follows.

*(To be continued.)*

## AMERICA'S ELECTRICAL TRADE.

BY MALCOLM CHALMERS.

WRITING in the ELECTRICAL REVIEW of November 2nd, 1917, I showed how the war's effect on the British and German electrical industries had given a great impetus to the American industry, and that the exports of electrical goods from the United States had gone up by leaps and bounds, more than doubling themselves in three years. The figures for the year ended June 30th, 1918, however, show that this wonderful improvement has not been maintained, the exports during that year, in spite of the general increase in prices which had taken place, being only about 4 per cent. larger than in the previous year. The following figures show the development since the outbreak of war, as compared with the last pre-war year:—

| | |
|---|---|
| Year ended June 30th, 1914 ... ... ... | £5,312,000 |
| " " " " 1915 ... ... ... | 4,187,000 |
| " " " " 1916 ... ... ... | 6,399,000 |
| " " " " 1917 ... ... ... | 10,931,000 |
| " " " " 1918 ... ... ... | 11,393,000 |

The increase last year over the previous year was thus only £462,000, whilst the 1916-17 trade was £4,582,000 in advance of that for 1915-16. Taking into consideration the fact that prices have risen considerably in the year, it is almost certain that the volume of trade during last year was really less than during the previous year. The reason, of course, is not far to seek. The entry of America into the war made large demands on the electrical industry in common with other American industries, and a rigorous supervision was kept on the export trade by the Government, in order that ample supplies might not be lacking both for the American and the Allied Armies.

Turning to the detailed figures, we find that the tendency has not been uniform throughout the industry, increases in some items being counterbalanced by considerable decreases in others. Thus, whilst there were apparently largely increased exports of metal filament lamps, transformers, meters, telephone instruments, and motors, there was a considerable decline in the exports of insulated wire and cables and electric locomotives, and smaller ones in the case of telegraph apparatus and arc and carbon filament lamps, whilst batteries and dynamos, having in view changes in prices, were probably shipped to about the same extent as in 1916-17. Certain items appear in the list for the first time, the exports, if any, in earlier years being included under the general heading, "other electrical goods." Among these a fair export trade was done in carbons, heating and cooking apparatus, magnetos and sparking plugs, and switches and accessories. In the following table the details for 1917-18 are given as compared with 1916-17:—

| | 1916-17. | 1917-18. | *Inc. or dec.* |
|---|---|---|---|
| Batteries ... ... ... | £627,000 | £698,000 | + £71,000 |
| Carbons ... ... ... | * | 318,000 | — |
| Dynamos & generators... | 532,000 | 560,000 | + 28,000 |
| Fans ... ... ... | 101,000 | 171,000 | + 70,000 |
| Heating and cooking apparatus ... ... | * | 111,000 | — |
| Insulated wire & cables ... | 1,498,000 | 1,191,000 | − 307,000 |
| Interior wiring supplies (inc. fixtures) ... ... | 234,000 | 319,000 | + 85,000 |
| Lamps: Arc ... ... | 3,300 | 2,700 | − 600 |
| Lamps: Incandescent, carbon filament ... | 33,000 | 30,000 | − 3,000 |
| Lamps: Metal filament | 446,000 | 663,000 | + 217,000 |
| Magnetos, sparking plugs, &c. ... ... | * | 660,000 | — |
| Meters and measuring instruments ... ... | 216,000 | 332,000 | + 116,000 |
| Motors ... ... ... | 1,228,000 | 1,375,000 | + 147,000 |
| Rheostats and controllers | * | 44,000 | — |
| Switches and accessories | * | 464,000 | — |
| Telegraph apparatus (inc. wireless apparatus) ... | 112,000 | 61,000 | − 51,000 |
| Telephone instruments ... | 407,000 | 535,000 | + 128,000 |
| Transformers ... ... | 263,000 | 466,000 | + 203,000 |
| Electric locomotives ... | 117,000 | 34,000 | − 83,000 |
| Other electrical goods ... | 5,112,000 | 3,359,000 | −1,753,000† |

* Included under "Other Electrical Goods" in this year.

† Allowing for the value of goods included under this heading in 1916-17, but, shown separately in 1917-18, there was an actual decline of £156,000.

It is, unfortunately, not possible to estimate the full effect of price fluctuations on these figures, as quantities are only shown in a few cases. Of these arc lamps, carbon-filament lamps and electric locomotives were exported to a considerably less extent, but in the case of fans and metal-filament lamps there were actual increases in the export figures over the figures of the previous year. The average prices, however, had risen during the year. Thus the number of fans exported last year were 54,022, at an average price of £3 3s. each compared with 38,396, at £2 11s. each in the previous year, and 32,816 at £2 15s. in the last pre-war year; 14,865,899 metal-filament lamps were exported last year, with an average value of 10½d. each, as compared with 10,703,531 in 1916-17, valued at 10d. each, and 849,261 at 1s. 1d. each prior to the war. Carbon-filament lamps were 35 per cent. dearer and arc lamps 96 per cent. dearer than in 1916-17.

As regards markets for America's electrical goods, Canada is easily first, that country taking no less than £2,112,000, or nearly 20 per cent. of America's total exports in 1916-17, and although similar particulars for 1917-18 are not available there is little doubt that this figure was well maintained. Chief among the classes of goods sent to Canada were batteries, dynamos, fans, lamps, motors, transformers, and telephones. Another good group of markets was Latin America, which in the aggregate took more than Canada—namely, £2,653,000—the principal countries contributing to this total being Argentina, Brazil, and Cuba. America has also improved her position in Australia and New Zealand, China, and Japan; whilst the United Kingdom, France, Italy, Spain, and India are other good markets for American electrical goods.

In spite of the comparative slump last year, the figures quoted above are sufficient to demonstrate the strong position that the American electrical industry has built up for itself in the world's markets since 1914. It must not be forgotten, moreover, that the home market is a very large

one, and, thanks to a highly protective tariff, it is almost entirely supplied by home products. The import trade is practically confined to a few lamps which were imported to the extent of about £136,000 in the last pre-war year, whilst last year the figure was less than £18,000.

Some idea of the size of the American electrical industry may be gathered from the fact that in 1914, the date of the last census of manufacturers, there were 1,030 concerns in the United States manufacturing electrical goods, with a combined capital of over £74,000,000 and employing some 118,000 persons. The value of the output of these concerns was about £70,000,000 in 1914, being an increase of 50 per cent. over the corresponding figure for the previous census, five years earlier. Since 1914 America has practically had the world's markets to herself and, as we have seen, has more than doubled her export trade in that time. During the war, moreover, the motor-car industry has developed marvellously, the output in 1917 being nearly two million cars as compared with about half a million in 1914, and the consequent increased demand on the electrical industry for batteries, magnetos, coils, sparking plugs, starting gear, and lighting sets must have been tremendous. Altogether, it seems as if the United States will be a very serious competitor against British electrical goods in the future, not only in markets such as Canada and Central and South America, where her close proximity to the markets will give her an advantage, but also in such countries as Australia, New Zealand, and British India. The question of the possible position in our own country must also not be lost sight of, and British manufacturers will need to study the question very seriously, if they are to regain the markets lost to them on account of the restrictions on export trade rendered necessary by the war.

## A TRAVELLING LIGHT.

By N. D. B. PHILLIPS, Lieut. R.E.

A convenient method for lighting a hospital operating table is illustrated in fig. 1. It consists of an ordinary counterweight fitting fixed to a block, on the upper side of which two grooved pulleys are screwed; these grooved

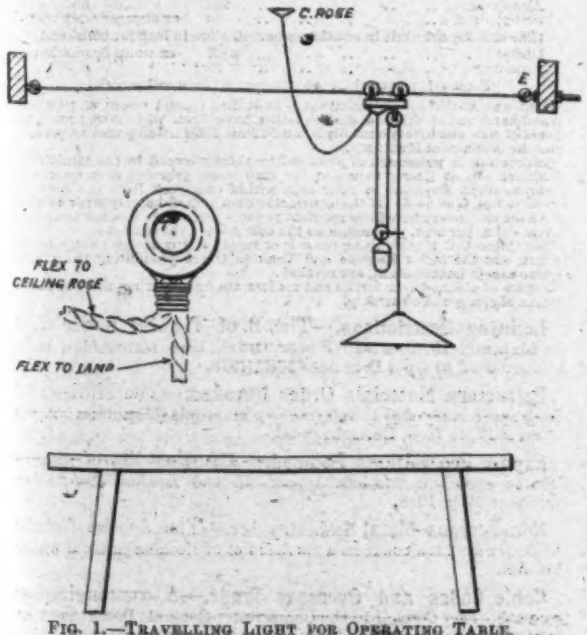


Fig. 1.—Travelling Light for Operating Table.
Fig. 2 (inset).—A Simpler Arrangement.

wheels run on a taut wire of No. 10 or 12 S.W.G. This wire is fastened at one end to an eyebolt in a beam, and at the other end to an eyebolt E, the latter threaded sufficiently to allow of its being tightened up by the nut.

The flex to the counterweight fitting is suspended from a ceiling rose, leaving sufficient slack to enable the fitting to be run as far as necessary in either direction. The ceiling rose should not be placed directly over the taut wire, but to one side of it, so that the flex will not foul the fitting when in its mid position.

Fig. 2 (inset) is a simpler arrangement, convenient for lighting a drawing board, or similar purpose. It consists of a small bobbin-insulator, round which the flex from ceiling rose to lamp is bound, and sliding on a taut wire T.

These devices, although rough and ready, were found very serviceable in France, and in many instances proved economical by enabling one light to suffice where more would otherwise have been needed.

## REVIEWS.

*Radio Communication, Theory, and Methods.* By J. Mills. Pp. 205; 120 figs. London: Hill Publishing Co., Ltd. Price 7s. 4d. net.

This book is one of peculiar interest. It is the substance of a course of lectures given by the author during the summer of 1917 to a company of the U.S. Reserve Signal Corps troops. The men concerned were, it is true, volunteers from the employés of the Western Electric Co., but the author states that they differed widely in the extent of their previous training in electrical engineering. The author claims to have adopted "a method which involved practically no mathematics except elementary algebra, and presupposed but a limited knowledge of physics." Yet in the very first chapter we find such expressions as

$$\epsilon^{j(\omega t + \pi)} = -j\,\epsilon^{j\omega t}.$$

In two introductory pages, the author removes the inexpert reader's dread and ignorance of the vector operator $j$ and the differential operator $p$ in about the simplest manner we have ever seen, and as we have here the substance of lectures designed to bring men, some of whom were relatively ignorant, into fighting trim as quickly as possible, we presume that the author was equally successful in familiarising them with the other mathematical expressions introduced so swiftly to their notice. That is nothing short of a remarkable achievement. At the worst, this book is of great value to those already well grounded in mathematics, and if it is really of practical value to students not so grounded, then the treatise is of quite extraordinary utility. It is always hard for one who has mastered initial difficulties to determine whether a given treatment removes all the obstacles likely to be encountered by the beginner, but from all the circumstances associated with this volume we believe that it imparts an exceptional degree of precise knowledge with unusual rapidity and sufficient detail.

Historical matter is excluded, and so, too, is matter of purely academic and speculative interest. Similarly, no detailed descriptions and instructions are given as to the construction and operation of apparatus. Primary attention is devoted to fundamental principles and methods, but one is seized by qualms as to whether these are not too frequently presented in a fundamentally mathematical manner. Chapter I is devoted to alternating currents and, starting off with quite elementary conceptions, ends up with conjugate vectors and vector impedance. This, in 24 pages, leaves the reader rather breathless unless he has had the text amplified by a good deal of lecture work, which is doubtless the intention. Chapter II deals with the telephone receiver, its characteristics from the "wireless" point of view, and the circle diagram for motional impedance. Two and three element vacuum tubes and vacuum amplifiers are next considered, after which there is a chapter on the detection and measurement of high-frequency currents. The heterodyne receiving system is included, together with some equations (three lines long) for conjugate vectors.

The production of damped sinusoidal currents and the phenomena of resonance are dealt with in Chapter V, which is excellent, but frankly bristling with algebra. The very important Chapter VI, on undamped high-frequency currents, is in much more practical vein, and gives a very useful treatment of high-frequency alternators and the Poulsen arc. Chapter VII, on radio-telegraphy and telephony, surveys simple and complex oscillators, types of aerials, ground systems, and the general methods of wireless telegraphy and telephony. The final chapter is concerned with practical appliances and methods of radio-telegraphy and utilises its space to excellent advantage. There is an appendix on transmission over wire circuits—excellent in the masterly nature of the survey effected, but involving hyperbolic functions, and certainly demanding amplification by a tutor before it could be absorbed by the reader for whom the book is intended. A selection of graded problems concludes the volume, and these, together with the rest of the book (which is admirably produced and well up to date), form a good basis for lecture treatment.

*Magnetism and Electricity for Home Study.* By H. E. Penrose. Pp. 515 + xiii; 225 figs. London: The Wireless Press, Ltd. (1918). Price 5s. net.

This book has been prepared primarily for the use of wireless students, and is intended to augment their knowledge of the elementary principles of magnetism and electricity. The usual methods of treatment are set aside in favour of the electron theory, upon which the author admittedly makes some severe demands, but which he regards as a satisfactory means of overcoming the genuine dislike of mathematical reasoning which he has found to exist in a large body of students. From an introduction by E. T. Fisk, of the Australian Wireless, we learn that Mr. Penrose has had a wide experience as instructor to various types of Navy, Army, and Mercantile wireless students, and that the object of the book is "that any person of any age could obtain a thorough grasp of elementary principles without previous acquaintance with the subject."

In 50 lessons the whole subject of electricity and magnetism is dealt with in a curiously discursive manner. We are led by awe-inspiring sentences up to the point at which we are bidden to "regard the universe as floating in an infinitely great ether ocean," and then, without warning, are commanded to "suspend a bar magnet from some convenient point in such a manner that it is free to turn," and merely arrive at the fact that unlike poles attract!

Some of the chapters are useful and straightforward to a degree, and the analogical treatment sometimes achieves a remarkable success. But on the whole the introduction of the ether would appear to muddle rather than clarify the treatment. The best chapters appear to us to be those in which the author follows more orthodox methods, and among these are the lessons on hysteresis, measurement of E.M.F. and current, D.C. generators, electrolysis, and accumulators.

We agree with the introductory statement that the lay-out of the book is unique, but, after a careful perusal, we are unable to find much virtue in this uniqueness. Rather, we are inclined to the opinion that Mr. Penrose would have done better had he been more orthodox, and we would observe that some of his heresies are entirely unforgivable. For example:—

"If two spheres A and B be subject to the same charging force (A having twice the superficial area of B), the charge produced on A must be twice the charge on B." (P. 303.)

"A point worth remembering in connection with the increase of resistance with temperature is that the resistivity is not affected." (P. 208.)

"The unit of force is that force which, acting for one second on a mass of one gramme produces an acceleration of one centimetre." (P. 500.)

While this definition of force may be merely *lapsus plumæ*, the two former errors are followed by further statements which, by re-stating and enlarging upon them, preclude the assumption that they are slips. Our suspicion that the author is something of an amateur physicist is confirmed when we read this remarkable outburst:—"Mass may be defined as the density of a unit volume of a given substance. In other words, it is the amount of substance contained per unit of volume. For instance, a 1-in. cube of beechwood does not contain so much matter as does an inch-cube of lead. The electromagnetic unit of mass is the gramme (1 oz. = 28.3495 grammes)."

We now begin to understand the cause of "the genuine dislike of mathematical reasoning" evinced by the author's students—and we fear that a wide use of this book would entangle many other students in a similar mathematical hopelessness.

While there are many good points in this book, its many shortcomings, errors and peculiarities make it impossible for us to recommend it as a suitable book for the use of electrical students.—P. H. S. K.

## BUSINESS NOTES.

**The "Electrical Review" Index.**—As it is still necessary to effect every possible economy in paper consumption, the index to Vol. 83 of the Electrical Review, which will shortly be printed, will be supplied only to those who, through the post, specially apply for it. To such it will be supplied for 3d. post free. Any reader or advertiser at Home or Abroad who requires a copy for binding, or for other purposes, is asked to make early application therefor to the Publisher, Electrical Review, 4, Ludgate Hill, London, E.C. 4.

**Control of Metals, Machinery, and Plant, &c.**—The following recapitulation of the modifications in the control of materials and machinery which have been made to date by the Ministry of Munitions since the cessation of hostilities, is issued for the guidance of manufacturers:—

*Priority.*—(*a*) Ordinary civil orders may now be placed and executed in Class C without priority permits or certificates. No further applications need, therefore, be made to the Priority Department of the Ministry of Munitions unless it is desired for national reasons to raise the priority of an order.

(*b*) Uncompleted contracts for the Admiralty, War Office, and Ministry of Munitions, which have been placed in Classes A or B, need no longer be given the priority attaching to them under the Order of Priority of March 8th, 1917, except in cases where the contractor is notified in writing or by official notice in the Press that a particular classification is still required to be given to any particular contract.

*Metals.*—(*a*) *Modification of Control.*—1. Iron, steel, and non-ferrous metal may be ordered, supplied, and used for Class C orders without priority classification or reference number from the Ministry of Munitions: and stocks purchased and held by Government contractors may be used for any class of work.

2. No permit is now required for the manufacture or sale of iron and steel wire or wire rope for home trade, and until further notice manufacturers of forgings, stampings, and castings in iron, steel, or malleable iron are at liberty to accept orders for priority below Class B.

3. The Control Orders forbidding dealing in non-ferrous metals without a licence, are suspended in the case of tin, copper, brass (including swarf and scrap), cupro-nickel, scrap, spelter, lead, platinum, chrome ore and type metals.

4. All restrictions as to the sale or purchase of calcium carbide have been removed, subject to a maximum price to consumers of £40 per ton for quantities of 1 cwt., and over.

(*b*) *Export Licences.*—1. Manufacturers must still continue, as hitherto, to obtain licences for export for articles made of steel and non-ferrous metals covered by the various schedules of the War Trade Department, but every effort will be made to grant these licences as freely as possible.

(*c*) *Prices.*—1. The maximum prices of steel for home trade are to continue at their present level until February 1st, 1919, when the direct subsidies paid by the Government on steel will cease, and a corresponding increase in price take place. A schedule of the prices to come into force on February 1st can be obtained on application to the Ministry of Munitions (C.I.S.P., Room 104, 8, Northumberland Avenue, S.W. 1). The present maximum prices of pig iron are to remain unchanged until April 30th, 1919, but post-war conditions are not yet sufficiently stable to warrant a fixing of prices after that date.

2. A schedule of fixed report prices for pig iron and steel, to take effect from November 18th, 1918, has been issued, and can be obtained on application to the Ministry of Munitions, as above. The prices, which are based upon the existing home prices, plus the subsidies paid by the Government, will remain in force until further notice. Upon all exports of pig iron, unmanufactured steel, and certain classes of semi-manufactured steel, a drawback will be collected by the Board of Customs and Excise, equivalent to the amount of the subsidy already paid by the Government on the articles in question. The items on which the drawback is chargeable are those whose prices are controlled and included in the schedules referred to in the preceding paragraph. Application for the schedule showing the amount of the drawback to be collected should be made to the Board of Customs and Excise, Lower Thames Street, London, E.C.

3. The following is a schedule of the present prices of non-ferrous metals from holdings of the Ministry:—

| | Per ton, buyers. | Delivered, works. |
|---|---|---|
| Copper, electrolytic | £125 | — |
| Brass ingot to Government specification | 99 | do. |
| Spelter, G.O.B. | 57 | do. |
| Refined, 99·9 per cent. | 61 | do. |
| Aluminium | 200 | do. |
| Soft pig-lead | 40 | ex steamer or ex store. |
| (The existing schedule in relation to manufacture in lead is abolished.) | | |
| Nickel | £195 | ex works or warehouse. |
| Antimony | 55 | do. |

These prices are subject to usual extras for small parcels.

*Plant and Machinery.*—Restrictions as to dealing in, and prices of, new and second-hand machinery and treadle lathes have been withdrawn; but purchases of new machinery can only be made from firms holding trading permits from the Ministry of Munitions.

Contractors in possession of plant and machinery owned by the Ministry of Munitions are at liberty to use it for civil work, provided they notify the Superintendent Engineer in their area within one week from the date on which it was first used. If the contractor does not ultimately wish to purchase the machinery he will be required to pay a reasonable hire not to exceed the rate of 2½ per cent. per annum on the cost price of the machine.

The Crane Order, prohibiting the sale or supply of any cranes except under permit, and the Motor Engines and Vehicles Order prohibiting the manufacture except under permit, are revoked.

Owners of steam-driven lorries and trailers are no longer required to make returns of charges of ownership.

**Lighting Restrictions.**—The B. of T. gives notice that the Lighting, Heating and Power Order, 1918, restrictions, have been removed as from December 23rd, 1918.

**Refractory Materials Order Revoked.**—The Minister of Munitions has revoked the Refractory Materials (Maximum Prices) Order, 1917, as from December 31st.

**Export Prohibitions Relaxed.**—A further list of relaxations in export restrictions appears in the *London Gazette* for December 27th, 1918.

**Non-Ferrous Metal Industry Act.**—The *London Gazette* for December 24th contains a further list of licences granted under this Act.

**Cable Codes and Overseas Trade.**—A communication from the Army Council to the Comptroller-General, Department of Overseas Trade, states that it is not possible to relax the restrictions relating to the use of telegraphic codes without the concurrence of the principal Allied Powers who have co-operated in the censorship during the war. The Army Council recognise the importance to the commercial community of allowing greater latitude in the use of cable codes, and the question of relaxation is now being discussed with the various Allied authorities.—*Board of Trade Journal.*

**Aluminium Order Suspended.**—The Minister of Munitions has suspended until further notice the Aluminium (Returns) Order, 1917, and the Aluminium (Scrap and Swarf) Order, 1917, as from December 24th.

**Resumption of Trade with Belgium.**—The Board of Trade calls attention in its *Journal* to the fact that the restrictions imposed by the Trading with the Enemy (Occupied Territory) Proclamation no longer apply to trading with Belgium, and that consequently the obligations to obtain a special licence under that proclamation, as well as the requirement to pay the purchase price for goods imported from Belgium into a blocked account in this country, are now dispensed with. Imports from Belgium into this country must, however, be accompanied by certificates of origin and interest issued in the usual form by a British Consular officer. Imports into, and exports from, Belgium are further controlled by the requirement of a licence issued by the Belgian authorities, particulars with regard to which can be obtained from the branch of the Department des Affaires Economiques which has been opened at 110, Cannon Street, London, E.C. 4.

**Sites for New Factories at Pietermaritzburg.**—The recent expansion of industrial activity in the Union of South Africa has, amongst other results, induced certain municipalities and similar public bodies to offer specially favourable terms to manufacturers in the way of water and power rates as well as sites for the establishment of industries. The Trade Commissioner for the Union has been notified that the Pietermaritzburg Corporation is prepared to offer suitable sites on very reasonable terms, and to submit plans with additional information as to supply of labour, raw materials, railway communications, &c. The water rate varies from 1s. 6d. per 1,000 gallons for a monthly consumption of 250,000 gallons to 9d. per gallon up to 12,000,000 gallons. Electricity can be supplied on a graduated basis of from 3d. to ·84d. per unit, and for industries of a kind not already established a reduction will be made of 33⅓ per cent. off these charges.

**Christmas Wishes and Social Functions.**—A Christmas staff and works function, arranged by the Social Committee of the AUTOMATIC TELEPHONE MANUFACTURING CO., LTD., and held at the Britannia Rooms, Cunard Buildings, Pier Head, Liverpool, on Friday, December 20th, from 6.30 to 10.30 p.m., took the form of a dance and whist drive. The function was a complete success. Some 300 guests attended.

THE ST. HELENS CABLE AND RUBBER CO., LTD., of Warrington, issued their Christmas wishes to "Our Fighters at Home and Abroad" in the form of a pamphlet containing a list of the names of 24 of their men who have made the supreme sacrifice in the war, and of 170 others who are "still going strong." Particulars of the work done in connection with the Works' Comfort Fund are followed by a number of appropriate messages from the different departments to the men still with the fighting Forces.

**British-Italian Trade and Industry.**—The *Bulletin* of the British Chamber of Commerce for July (Inc.) which has come to hand contains a number of appropriate "Victory" messages. It is recognised that Britain and Italy should now fight side by side in Peace as they have done in war, and in this connection we make the following extracts from an article which immediately follows the messages referred to :—

"During the war many industries in Italy have undergone considerable development. . . . The principal engineering industries, production of motor cars, aeroplanes, &c., have made great strides. In fact, Italy now claims to possess the largest automobile industry in Europe. Among other industries which may be singled out as having received a great impetus from the war, and which were practically non-existant in Italy up to 1915, may be mentioned the manufacture of fire-bricks, &c., in connection with the metallurgical furnaces, the production of scientific and optical instruments, electric reflectors, and ignition magnets for automobiles. The manufacture of certain chemicals has made progress, and there are several new schemes under consideration more or less connected therewith, *e.g.* :—

1. The institution of a big bank to favour electrical undertakings and hydro-electric plants after the war, the building of electric machinery to be specially aided.
2. The formation of a military technical corps of 3,000 engineers.
3. Various schemes *re* the electrolytic zinc industry.
4. The nomination of a Special Committee to foster the development of nitrate products.
5. Scheme to discipline the rationing of electric power and to encourage building plants.
6. The creation of an Invention and Research Office and an Office for War Chemicals.

The enterprise of Italians will lead to the development of industries on a large scale, and much of the machinery and raw material required will be imported. Among the developments expected, the following will probably be taken in hand first :—

1. Enlargement of ports and construction of wharves, &c., necessary to relieve congestion, so as to provide for proper development of shipping.
2. Overhaul of the railway system, and the electrification of lines.
3. Utilisation of further water power for the creation of electric energy, and the building of requisite reservoirs.
4. Fuller cultivation of the land, and the reclamation of wastes for agricultural purposes.
5. Adaptation of factories used for munition making for industrial purposes.

In connection therewith, a large demand is certain to arise for machinery and engineering plant, constructional iron and steel and building materials, agricultural machinery and implements, rolling stock, mill and factory furnishings, &c.

Not only commercially, but also financially, intellectually, and politically, relations between Britain and Italy should be much closer, more intimate and efficient than in the past. On both sides, Government and Parliament corporate bodies, associations of every sort; scientific, literary, sporting; steamship companies, industrial and commercial firms and private individuals should, as far as lies in their power, favour, promote, support, foster, and encourage relations of every kind, and especially financial, economical, and commercial, between the two countries.

Although the British Empire itself offers such an immense field to British manufacturers, it should be in their own interest to devote much more attention to Italy before the Teutons are in a position to recommence their work of "peaceful penetration" as far as new conditions will allow, recollecting that Italians are more than ever anxious to develop their commercial relations preferentially with the British Empire, to which Italy is tied by traditional sympathy. British firms should not fail to :—

1. Send out commercial travellers, or appoint agents, in order to see buyers on the spot and find out exactly what kinds of goods they, the customers, want.
2. Supply agents, when necessary and expedient, with a certain stock of goods from which to execute small orders promptly and supply part of large orders in order to retain clients.
3. Correspond in Italian, have catalogues printed in that language, and quote prices in the currency, weights, and measures of the country.

Italy is one of the most important countries with which Britain may hope to develop business on a much larger scale than in the past. The British Empire has goods Italians want, and Italy has commodities that the Empire needs. Economically Italy is growing by leaps and bounds, and her strides during the war in some respects have been prodigious; this, with the economic education which war brings to the peasant soldier, will have its favourable reaction on the Italian market, benefiting both her and her customers and clients."

**Letters from the Forces.**—In a recent letter from a correspondent with the R.A.F. abroad, the writer says :—"Many thanks for the REVIEWS, which have always reached me most regularly. I am shortly on my way to 'Blighty,' and I take this opportunity of thanking you, on behalf of my chums and myself, for your generosity, which has not only been a help to us and to the Forces in which we are proud to serve, but has been the means of enlightening us regarding the numerous changes in the electrical industry and the conditions of home, so that we shall not be total strangers in our Homeland when we return."

**New Italian Industries During the War.**—According to the most exact recent news obtainable, about 2,500 millions of lire (100 millions sterling) of new capital have been invested in Italian industries during the war, approximately as follows :—Transports, land and sea, 545 millions; siderurgical industries, 432 millions; electrical industries, 405 millions; banking, 278 millions; mechanical engineering, 267 millions; chemical and electrochemical industries, 217 millions; mining industries, 173 millions; automobile industry, 100 millions; textile industries, 80 millions. This only goes as far as June, 1918, while it is well known that since then many limited companies have greatly increased their share capital (one company by as much as lire 400,000,000), and does not take into account at all other private companies and partnerships. The true sum total is, therefore, more likely to be 3,500 million lire, say, 140 millions sterling.—*Bulletin* of the British Chamber of Commerce for Italy.

**Scrap Copper from the Fields of Battle.**—A question which is now occupying the minds of experts is how much of the precious metal can be salved on the battlefields of three continents. It is asserted that something like 3,000,000 tons of copper lie on the battlefields of Belgium and France, not to mention the thousands of tons in Russia, Serbia, the Balkans, Italy, Bulgaria, Rumania, Palestine, Egypt, Mesopotamia, and other places where the dogs of war were let loose by the ex-Kaiser. It is said that of the scrap copper in France and Belgium, at least 1,000,000 tons can be recovered, or about equal to one year's output of the United States. It is now known that for five years prior to the war Germany purchased at least 200,000 tons per annum for herself and her Allies, and her purchases were so skilfully camouflaged that the destinations of the copper were seldom suspected. Germany is now practically denuded of copper, and the Peace Conference will probably see that she gets none of the battlefield scrap.

**Irish Coal Output in 1917.**—A White Paper just issued shows that in 1917 the output of the coal in Ireland was 95,646 tons, and the value £87,164. Of this, 80,301 tons were anthracite, mainly from the Kilkenny mines, the figures for Kilkenny being 61,742 tons; Queen's County, 14,156 tons; and Tipperary, 4,403 The Roscommon mines produced 12,487 tons, for which £1 per ton was paid at the pit head. In coke, 395,368 tons of coal were used, producing 188,704 tons of coke. Iron ore was produced to the extent of 54,533 tons, valued at £14,266. The average of iron obtained was 38·44 per cent., and the quantity of pig iron 29,972 tons. In Sligo, 16 tons of zinc ore were obtained, and 5 tons of zinc obtained by smelting. The figures of the coal output in the year just closed will be considerably in advance of those of 1917, the efforts to meet the shortage having considerably increased the output in the east and west, and at present some coal is being got from the Tyrone field at Dungannon. The shortage of coal in Ireland is being severely felt, the greater part of the imported fuel being obtained from Scottish mines.

**Demobilisation.**—The War Office announces that officers and men cannot at present be demobilised from certain corps in the Army, as they are essential to the work of demobilisation. The fact that employment awaits an individual will be recorded with a view to his being demobilised as early as possible. The corps in question are :—Royal Army Service Corps, Ordnance Corps, Veterinary Corps, Remount Corps, Army Pay Corps, Directorate of Military Railways, France.

**Iron and Steel Prices.**—The Minister of Munitions has issued certain information supplementing the notices which have already appeared with regard to home and export prices of iron and steel.

**Country of Origin.**—A Bill requiring all goods to be marked clearly with the name of the country of origin has been passed by the Australian House of Assembly, which prevents German goods, after passing the Customs, from being labelled "Made in Australia."—*The Times.*

**Another Accumulator Trade Combination.**—An important amalgamation of interests has just been effected in the accumulator manufacturing business by the combination of the New Peto & Radford Accumulator Co. with the Pritchett and Gold and Electrical Power Storage Co., Ltd. The first of these concerns has been identified with the production of portable accumulators for motor-cars since the early days of motoring. The Pritchett & Gold concern, which has been employed on work of a heavier character, is itself a war-time amalgamation of the old Pritchett & Gold Co. and the Electrical Power Storage Co., the co-operation of interests being arranged as a step towards economy of production and the establishment of the business on a large scale. The second amalgamation is, we understand, the consequence of the recognition that the portable accumulator business is destined to become an important one, and the acquisition of the Peto & Radford business was considered to afford an opportunity of starting in, and so specialising in, this class of trade. The proprietary name of Peto & Radford is not to disappear, as the portable accumulators will continue to be produced under that name and under the supervision of Mr. William Peto and Mr. G. R. N. Minchin, though eventually the manufacture will be transferred to the large works at Dagenham, Essex, where building extensions are already in hand.

**The Requirements of France.**—It is stated that priority is now allowed in France to the importation of steel, copper, zinc, lead, aluminium, machinery, tools, electrical appliances, &c., required for the liberated regions.

**British Malaya: Warning.**—Prospective rubber planters are cautioned against proceeding to Malaya without first securing definite appointments. It is also necessary to remember that the cost of living has advanced there, as elsewhere.

**Tramcar Driver Fined.**—For driving a Corporation tramcar to the danger of the public, Walter Wilson was fined 20s. at Barrow last week. It was stated that, instead of going to the points at the terminus, and crossing on to the other line, he returned at an excessive speed along the same line, passing another car going in the same direction.

**Trade Announcement.**—Mr. F. Young has commenced business as an electrical engineer at 43, Roebuck Road, Rochester.

**For Sale.**—Oldham Corporation Electricity Works has for disposal four Willans-Siemens 740-kw. sets, eight dryback marine type boilers, with underfeed stokers and superheaters. For particulars see our advertisement pages to-day.

**Munition Workers' Carol Party.**—The Musical Society, which is run by the staff and employés of the Osram-Robertson Lamp Works, Ltd., of Brook Green, completed just prior to the Christmas holidays a very successful carol-singing campaign on behalf of St. Dunstan's Hostel. The amount collected in five nights was £110, which is probably one of the largest collections ever made by a carol party in so short a period. The party consisted entirely of munition workers.

**Liquidations.**—Electric Lighting & Engineering Co., Ltd.—Meeting, January 24th, 1919, at 43, Castle Street, Liverpool, to hear an account of the winding up from the liquidator, Mr. R. T. Langdon.

Expanded Metal Co., Ltd.—Meeting of creditors, York Mansion, S.W. 1, on January 7th.

**Bankruptcy Proceedings.**—A. F. Hawdon, electrical engineer, Gosforth.—Application for debtor's discharge to be heard at Newcastle, January 16th.

**Book Notices.**—The Christmas number of *The M. & C. Apprentices' Magazine* contains so much that is interesting and entertaining, that it is difficult to pick out items for notice; as a matter of fact, it takes up too much of our time, and we shall have to review it from the table of contents in future! Mr. Sam Mavor writes of Baku, Mr. Bousfield of Alsace-Lorraine, Mr. Davies of "Iron," Ald. Duncan Watson of his apprenticeship, and Mr. P. Black of the education of skilled craftsmen; and there are numerous short articles and notes, and spirited illustrations. The interesting announcement is made that Messrs. Mavor & Coulson will give a gold medal next Christmas to the best fifth-year apprentice, to be selected by the apprentices themselves.

"Electricity and Magnetism for Engineers." Part 1: Electric and Magnetic Circuits. By Harold Pender. Pp. xi + 380; 98 figs. London: Hill Publishing Co., Ltd. 1918. Price $3 net.

"*Journal* of the Institution of Electrical Engineers." Vol. 57. No. 277. December, 1918. London: E. & F. N. Spon, Ltd. Price 7s.—This issue contains a paper on "Dynamical Theory of Electric Engines" (Tenth Kelvin Lecture), by Lt. B. Atkinson, and the Chairmen's addresses at the following centres: Irish (Mr. J. P. Tierney); Western (Mr. H. I. Rogers); North-Eastern (Mr. A. P. Pyne); North-Western (Mr. A. P. M. Fleming); Scottish (Mr. J. F. Nielson); and North-Midland (Mr. R. H. Campion).

**Calendars and Diaries.**—Messrs. Peckham, Ducamp and Co., of 4 and 5, New Compton Street, Charing Cross Road, London, W.C. 2, have prepared for 1919 one of their useful desk reminders with daily memoranda space, which is ample for ordinary business purposes.

The Anglo-Mexican Petroleum Co., Ltd., of 16, Finsbury Circus, London, E.C. 2, have issued a wall calendar with monthly date slips, below a reproduction in fac-simile of a drawing of the Mexican Eagle Oil Co.'s famous gusher Potrero No. 4, which has just ceased to yield. Beneath the date slips there is a picture of a British squadron, and a quotation from Lord Fisher on the value of an oil fired fleet.

From the Hart Accumulator Co., Ltd., of Marshgate Lane, Stratford, London, we have received, as in previous years, a desk blotting pad. Each sheet bears at the left and right-hand sides a complete calendar for 1919.

**Catalogue.**—The Hoffmann Manufacturing Co., Ltd., Chelmsford.—Abridged edition (36 pages) of their catalogue of Hoffmann steel balls and rollers and ball and roller bearings. There is a thumb index to sections. Sizes, prices, and code-words are set forth clearly in table form. Copies of the list can be obtained on application.

**The "English Electric" Amalgamation.**—The amalgamation arrangements foreshadowed by the chairman at Dick, Kerr and Co.'s annual meeting have now been completed, and circulars have been issued to the shareholders giving details. A new company has been formed, named the English Electric Co., Ltd., which has already acquired all the shares of the Coventry Ordnance Works, Ltd., and the Phœnix Dynamo Manufacturing Co., Ltd., both of which are private concerns; and an offer is now made to Dick, Kerr's shareholders to exchange their shares on terms which are strongly recommended by the directors, who are backing their opinion by accepting the offer themselves.

The English Electric Co., Ltd., concerning which we gave some particulars in our "New Companies Registered," last week, has a registered capital of £5,000,000, of which less than £2,000,000 will have been issued when the proposed exchange with Dick, Kerr shareholders is completed, so that it is evident that the directors have the intention of considerable further expansion. As it is, the company will be one of the principal electrical manufacturing concerns in this country. The Board is a strong one, and representative of the leading engineering industrials. As a matter of fact, the directors themselves can through their other connections materially support the company with orders. It is interesting to note that three of our main-line railways are represented on the Board, by Sir Charles Ellis for the Great Eastern Railway, Mr. Hichens for the London and North-Western, and Mr. Bernard Firth for the Great Northern. Equally important is the representation of our shipbuilding and owning interests, with Mr. John Sampson as a director of Harland & Wolff, and Sir Alexander Gracie of the Fairfield Shipbuilding and Engineering Co., together with the chairman and Mr. Hichens, representing respectively John Brown & Co. and Cammell, Laird & Co.

We announced, a week or two ago, that Mr. Evan Parry had resigned his post of Chief Government Electrician in New Zealand. The reason for this resignation is now apparent, for Mr. Parry has been appointed engineer-in-chief of the English Electric Co., Ltd. That he will be heartily welcomed home to Old England again by his many electrical friends, goes without saying.

**D.K. Operatic Society.**—The employés of Messrs. Dick, Kerr & Co., Ltd., Preston, have formed an amateur operatic society, and last week the members gave a series of very successful performances of "H.M.S. Pinafore" in the Empire Theatre, Preston.

## LIGHTING AND POWER NOTES.

**Ascot.**—Proposed Price Increase.—The Electricity Co. has applied to the B. of T. for an order to increase the maximum price of electricity from 11s. 8d. up to 20 units, and 7d. per unit beyond, to 12s., and 1s. per unit.

**Batley.**—Price Increase.—The electricity charges are to be increased by a further 20 per cent. from February 1st, thus raising the charge for lighting to 55 per cent. above the pre-war rate, and that for power and heating to 75 per cent.

**Bolton.**—Proposed Linking-up.—The Corporation has decided to apply to the L.G.B. for sanction to a loan of £7,500, for the purpose of connecting its electricity supply system with that of the Lancashire Electric Power Co.; it is proposed to enter into a mutual working arrangement for 10 years.

**Bournemouth.**—Price Increase.—The E.S. Co. has notified its intention to increase the price of electricity to 8½d. per unit, a total war-time advance of 33⅓ per cent.

**Canada.**—Water Power.—A company has sought authorisation from the Quebec Government to proceed with a hydro-electric development on the Riviere des Prairies, Island of Montreal. The preliminary plans provide for a development of 40,000 h.p. Federal sanction has already been obtained, subject to modifications of the original plan, and provincial authority is required for the use of the bed of the stream. The power house will be on the south shore of Jesus Island, and the preliminary plans provide for nine units. The project will raise the water level some 15 ft., and will interfere with the sewer outlets of Montreal,

**Continental.**—SPAIN.—A concession has been granted for the utilisation of the River Guadalpeo (Izbor), near Meleges, for the generation of electricity.

**Egham.**—STREET LIGHTING.—The U.D.C. has decided to enter into a 10 years' contract with the Egham and Staines Electricity Co., for street lighting.

**Falkirk.**—PROPOSED JOINT SUPPLY.—Representatives of the Burghs of Stirling, Alloa, Grangemouth, Bo'ness, Linlithgow, Denny, Bathgate, and Armadale, and the County Council of Stirlingshire have been asked to confer with the Falkirk T.C. regarding the provision of joint electrical plant.

**Ilford.**—PROPOSED EXTENSIONS.—The electrical engineer has been instructed to report to the Corporation upon the alterations and additions required in connection with the plant.

**Ipswich.**—YEAR'S WORKING.—There was a surplus of £2,175 on the working of the Corporation Electricity Department for the year ended March 31st last, of which £1,588 was credited to the reserve fund, and £474 to the liquidation of the adverse balance on the previous year's working. The income was £55,720, compared with £39,580 in the preceding year, and the working expenses were £40,304, against £26,825; capital charges absorbed £12,848. Units sold increased from 4,836,171 to 6,797,374, of which 843,227 were for lighting, against 730,821; 5,245,491, against 3,444,886, for power; and 708,653, against 660,464, for tramways. The capacity of the undertaking was 3,511 KW., and the maximum load recorded was 3,113 KW. The generation cost was 1·14d. per unit, and the total cost (excluding capital charges) was 1·423d. The average price per unit, excluding meter rents, &c., was 1·772d. The year's operation of the electric vehicle garage showed a surplus of £44. 65 per cent. of the energy sold for power purposes was consumed by controlled munition factories. In his report, the electrical engineer (Mr. F. Ayton) states that the coal cost per unit sold was ·828d., against ·678d., due almost entirely to the overloaded condition under which the plant was worked, and to the fact that much of the output was generated by the old reciprocating plant. There were many occasions during the year when, owing to the poor quality and poor supply of coal, the undertaking was unable to maintain sufficient steam, and had to appeal to the large power users to ease their demand. The item for "repairs and maintenance" increased from £1,756 to £3,533. 500-KW. rotary converters, with transformers and switchgear, were installed at the power station and the Duke Street sub-station for converting current for transmission to the foundry district. The plant had to be obtained in a great hurry, and the only suitable plant that could be found was of a make which had not proved reliable or satisfactory. The plant was started on May 3rd, and gave trouble from the first. On July 25th it broke down, and was out of commission until October 1st; it was also out of commission from December 18th until January 29th. The repairs have been carried out at the makers' expense, but the breakdowns involved the stopping of very important plant at the Orwell works, and a consequent loss of revenue.

**Luton.**—LOAN SANCTION.—The E.C. has obtained L.G.B. sanction to borrow £2,000 (repayable in 25 years) for extension of mains for providing additional supply of electricity to Thermo Electric, Ltd., and Fricker's Metal Co.

**Mansfield.**—PRICE INCREASE.—The T.C. has increased the charges for electricity by a further 25 per cent., making 50 per cent. over pre-war rates.

**Methley.**—PROPOSED BULK SUPPLY.—The U.D.C. has asked the Yorkshire E.P. Co. to submit terms for a supply of electricity in bulk.

**Nelson.**—PROPOSED LINKING-UP.—A joint meeting between representatives of the Nelson and Colne Corporations has been arranged to consider proposals for the interconnection of the electricity supply systems.

**Newark.**—PROV. ORDER.—The T.C. has decided to oppose an application by the Newark Gas Co. for an E.L. prov. order.

**Normanton.**—E.I. SCHEME.—The U.D.C. has decided to push forward with the electric lighting scheme.

**Oldham.**—FIRE.—A fire broke out in the generating station at Asia Mill, Hollinwood, last week, and considerable damage was done to the plant by the collapse of the roof.

MILL DRIVING.—Referring to the application from three large mills for a supply of electricity, the chairman of the Electricity Committee stated that he believed that the demand for electricity was about to develop very considerably, and the Committee should seriously consider its whole position.

**United States.**—HETCH HETCHY SCHEME.—The Hetch Hetchy project, when completely developed, includes dams, tunnels, pipes, and aqueducts of sufficient capacity to deliver and distribute 400,000,000 gallons of water daily to the San Francisco Bay region from its mountain supply in the High Sierra situated 160 miles to the east. In addition to this, the completed project as now proposed includes the development of a number of attractive power sites. This completed project will undoubtedly represent an investment of approximately 125 to 140 millions of dollars. A description of this project as it appears to-day is given in the *Journal of Electricity* for November 15th.

In his report of March, 1916, the City Engineer of San Francisco sets forth a statement showing that an outlay of $44,147,000 will be necessary to complete the project sufficiently to deliver to San Francisco a domestic water supply of 60,000,000 gallons daily, and to erect at the Moccasin Creek power plant an initial installation of 37,500 KW. Since these estimates were made prices have advanced to such a degree that it is reasonable to expect an outlay of $60,000,000 will be necessary for this work. To acquire a distribution system such as the Spring Valley and the necessary reserve reservoirs an additional $40,000,000 will be necessary. To eventually complete the project so as to deliver the 400,000,000 gallons daily, and in addition to erect power lines and build all the other necessary appurtenances will require at least an additional $25,000,000, or even $40,000,000. That this completed project may cost between $125,000,000 and $140,000,000 does not in itself condemn the undertaking. Tersely put, the outstanding facts are these:—Some 20 cities and municipalities in the San Francisco Bay region need improved water facilities, and the need is far greater than is generally realised. While the Hetch Hetchy project has been reported on by experts, its alternative possibilities of development have never been properly weighed in careful analysis. The power phase of the situation, while attractive on the surface, has never been completely and thoroughly examined. The project, as a whole, is admittedly larger than San Francisco of itself can reasonably finance or, without supplying other municipalities, reduce to a paying investment. The urgent and dangerous situation that may arise from a season of water shortage extending over a two-year period, which may arise at any time, must not be overlooked.

## TRAMWAY AND RAILWAY NOTES.

**Aberdeen.**—PROPOSED LIGHT RAILWAY.—The Corporation Electricity Committee has reported in favour of the construction of a light railway between the electricity works and the docks and railway station, for the conveyance of coal; the estimated cost is £20,000.

**Australia.**—STRIKE.—The tramway employés at Perth (West Australia) have struck work for higher wages.

**Blackburn.**—STRIKE.—The employés of the Corporation tramway department, who are members of the Amalgamated Tramway Workers' Union, have refused to work with the members of the Municipal Employés' Union, and struck work on Monday last. The strikers have asked the Lancashire District Council of the Workers' Union to declare a strike of tramway workers throughout the county. They have also called out the men engaged on carting coal to the electricity works, thus threatening the supply for lighting and power.

**Brighouse.**—PROPOSED TRAMWAYS.—A Sub-Committee has been appointed to interview the chairman of the Huddersfield Tramways Committee with regard to the proposed tramways to Rastrick.

**Doncaster.**—PROPOSED EXTENSIONS.—The T.C. has decided to carry out improvement schemes in the borough, including the extension of the tramway system; the total cost is estimated at £600,000.

**Halifax.**—TRACK RENEWALS.—The Tramways Committee has given instructions for the repair of the tramway track between Hipperholme and Brighouse and between Brighouse and Bailiffe Bridge.

**Huntingdonshire.**—PROPOSED LIGHT RAILWAY.—The C.C. has decided to ask the Norman Cross Brick Co. to co-operate with the Council in the provision of a light railway for the district.

**Ipswich.**—YEAR'S WORKING.—For the year ended March 31st, 1918, the revenue of the Corporation tramway department amounted to £34,817 and the expenditure to £27,071, compared with £25,567 and £21,922 respectively in the previous year. Loan redemption amounted to £2,413, against £2,340; interest to £3,244, against £3,315; and war allowances to employés to £611, against £672. The net profit was £1,478, against a loss of £2,672 on the previous year's working; 625,224 car-miles were run, against 567,503; 6,069,777 passengers were carried, against 6,246,820; 708,653 units were used, against 660,464; 1·134 units were used per car-mile, against 1·164; the total working expenses per car-mile were 10·392d., against 9·271d.; and the total revenue per car-mile was 13·365d., against 10·812d. Energy, obtained from the electricity department, cost £5,211, or 2d. per car-mile, against £4,300. The manager (Mr. F. Ayton) estimates that the whole of the track will require renewing, at a cost of £42,500, next year, and also recommends that certain useless or unprofitable routes be abandoned.

**Ilford.**—SUPPLY OF ELECTRICITY.—The Corporation electrical engineer and tramway manager has been instructed to endeavour to obtain a supply of electricity from neighbouring tramway authorities, in order to meet any emergencies which may be caused by breakdowns.

**L.B. & S.C.R. Electrification.**—A copy of a resolution passed by the Brighton T.C., to the effect that the Council is strongly of opinion that the electrification of the main line from London to Brighton should be proceeded with at the earliest possible moment, has been forwarded to the company.

**Llandudno.**—SUPPLY OF ELECTRICITY.—A new agreement, by which the U.D.C. is to supply electricity to the Llandudno and Colwyn Bay Electric Railway Co. on a sliding scale based on the cost of fuel, comes into operation on January 1st.

**London.**—M.E.T.—The Metropolitan Electric Tramway Co. has given each employé a day's pay in celebration of the Armistice.

FARE INCREASE.—The London United Tramway Co. increased its fares on January 1st to 1d. for two stages, in place of three. There is no change in workmen's fares for the present. Should the change not result in the increase of revenue that is required, the matter will be further considered in two months' time.

DEVELOPMENT COMMITTEE.—Early this year a conference of representatives of municipal tramway authorities in the Metropolitan area will be held to consider the following resolutions, which were adopted at a recent meeting of the Metropolitan Association of Tramway Managers:—(1) That the Metropolitan Association of Tramway Managers, which includes in its membership managers of both municipal and company-owned tramways, be dissolved; (2) that a new association be formed consisting of municipal authorities owning and working tramways or motor vehicles; that the municipal authorities be represented by not more than two members each and the managers of the undertakings; that the meetings of the Council be held quarterly; that meetings of the managers be held at least once a month; and that the managers act jointly in an advisory capacity to the Council on all matters which affect the common interests of the undertakings in the Metropolitan area.

**Mersey Docks.**—A big scheme for the electrification of the Mersey Dock Estate has been adopted, with a view to the extended introduction of electrically-worked mechanical appliances on the dock quays; the cost is estimated at £123,900.

**South Africa.**—RAILWAY ELECTRIFICATION.—The report of the General Manager of Railways and Harbours for 1918 states that the services of a London firm of consulting engineers had been secured to report upon the proposed electrification of certain sections of the Union railways, and a representative of the firm had already been to South Africa to study local conditions and collect data.

**Stirling.**—It is proposed to lay a light railway from Stirling to Port of Monteith.

**The Electric Vehicle Committee.**—Mr. E. E. Hoadley, the engineer and manager of the Maidstone Corporation electricity supply department, has been added to the Electric Vehicle Committee as an additional representative of the Incorporated Municipal Electrical Association. Another addition to the Committee is Lieut.-Colonel Frank Garrett, of Messrs. Richard Garrett & Sons, Ltd., Leiston, Suffolk, who takes the place as a representative of electric vehicle manufacturers of Mr. Meaden, of Wolseley Motors, Ltd., Birmingham, who are no longer interested in electric vehicles.

**Thornaby.**—PROV. ORDER.—The T.C. has decided to apply for a prov. order to construct and work tramways within its area.

**Thornton.**—RAILWAY EXTENSION.—The Lancashire and Yorkshire and London and North-Western Railway Companies have notified the Council of their intention to promote a Bill for the construction of a branch railway, to be called the Cleveleys branch.

**Wages.**—The National Transport Workers' Federation has forwarded the following demands on behalf of its members to the Municipal Tramways Association and the Tramways and Light Railways Association:—The working week to consist of 44 hours, including signing on and off, and every employé to be guaranteed a working week of 44 hours or payment for the same; no day's work to exceed eight hours; a reduction of the working day not to entail a reduction of existing wages; no "spread-over" duty to exceed nine hours, inclusive of meal times or relief; all Sundays, national holidays, and overtime to be paid for at time-and-a-half rates; 14 days' holiday to be granted annually, with pay. The two Associations have agreed to meet representatives of the Federation early this year to discuss the proposals.

**Weston-super-Mare.**—EXTENSION OF TIME.—The promoters of the Western Junction Light Railway Order, 1910, have applied to the B. of T. for an extension until December 31st, 1919, for the completion of the unconstructed lines authorised by the Order.

## TELEGRAPH AND TELEPHONE NOTES.

**Abbreviated Addresses.** — The Postmaster-General announces that from January 1st the use in foreign telegrams of abbreviated addresses will be allowed. The registration of new abbreviated addresses for foreign telegrams has been sanctioned.

**Australia.**—As a result of the finding of the Navy Commission in connection with the purchase of a wireless station by the Australian Government, Senator Long has resigned his seat in the Senate. The Commission expressed the opinion that Senator Long received £2,400 in consideration of his political influence.—*The Times.*

**Haiti.**—The telephone systems of Haiti and the Dominican Republic have recently been connected. It is now possible to communicate between the principal towns of the two Republics.

**United States.**—The first extensive strike of telephone workers occurring since Government control of wires was assumed, which involved operators and electricians at Norfolk, Va., was settled on November 1st, upon a direct demand addressed to the strikers by Postmaster-General Burleson, who said that no strike could be recognised in the Government service. Employés had 24 hours in which to return after leaving their positions, and the management of the company involved had orders at the end of that period to fill all places left vacant with other workers, and to report the names of those leaving the service.

The P.M.G. has appointed Committees to make recommendations with a view to standardising the rate schedules of telephone and telegraph services throughout the States.

The restrictions heretofore placed on telephone extensions have been revoked.—*Telephone Engineer.*

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Australia.**—SYDNEY.—April 28th. City Council. Supply and erection of power-house switchgear. Specifications from Electric Lighting Department, Town Hall, Sydney.

MELBOURNE.—March 10th. City Council. One 5,000-KW. frequency changer, high-tension switchgear. Specification (£1 1s.) from City Electrical Engineer.

**Dublin.**—Electricity Committee. Erection of a fan house at Pigeon House Fort Station.

**London.**—HAMPSTEAD.—B.C. January 16th. Twelve months' supply of electrical engineers' stores and oils for the Electricity Station. Mr. A. P. Johnson, Town Clerk, Town Hall, Haverstock Hill, N.W.

**Spain.**—The municipal authorities of Albaida (Province of Valencia) have lately invited tenders for the concession for the electric lighting of the town during an unstated period. Tenders have also been invited for the concession for the electric lighting of the Town of Pedrochi (Province of Cordoba) during a period of five years.

**Sheffield.**—January 7th. Corporation Tramways and Motor Committee. 50 double-decked, top-covered, vestibule tramcar bodies with trucks. Mr. A. R. Fearnley, General Manager, Division Street.

### CLOSED.

**Australia.**—Commonwealth Department of Defence :—
Electric motors for dock pumps, Commonwealth Dockyard, £5,796.—Lancashire Dynamo & Motor Co., Ltd.

**Ilford.**—U.D.C. :—
23-H.P. motor and starter, £145.—W. H. Sugden.

**Windsor.**—T.C. :—
Pulsometer pump and 50-H.P. motor and mains.—Windsor Electrical Installation Co., Ltd., £775.

## FORTHCOMING EVENTS.

**Junior Institution of Engineers.**—Friday, January 3rd. At 39, Victoria Street, S.W. At 7.30 p.m. Paper on "Concrete Ships," by Mr. P. M. Fraser.

**(North-Eastern Section).**—Tuesday, January 7th. At the Mining Institute, Newcastle-on-Tyne. At 7.45 p.m. Paper on "Design of High-speed Generating Units," by Mr. G. Bonner.

**Chief Technical Assistants' Association.**—Saturday, January 4th. At 3 p.m. At Anderton's Hotel, Fleet Street, E.C. Ordinary meeting.

**Institute of Marine Engineers.**—Tuesday, January 7th. At the Minories E.1. At 6 p.m. President's address.

**Roentgen Society.**—Tuesday, January 7th. At the Royal Society of Arts, John Street, W.C. At 8.15 p.m. Paper on "Electrical Changes Produced by Light," by Mr. H. S. Allen.

**Association of Engineers-in-Charge.**—Wednesday, January 8th. At 7.30 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "The Transport and Handling of Fuel," by Mr. J. H. Anderson.

**Industrial Reconstruction Council.**—Wednesday, January 8th. At the Saddlers' Hall, Cheapside, E.C. Lecture on "Industrial Unity," by the Rt. Hon. G. H. Roberts, M.P.

**Greenock Association of Electrical Engineers.**—Thursday, January 9th. At 22, West Stuart Street. At 7.45 p.m. Paper on "An Hour with Ultimate Electricity," by Mr. P. C. Kerr.

**Institution of Electrical Engineers.**—Thursday, January 9th. At the Institution of Civil Engineers, Gt. George Street, S.W. At 6 p.m. Lecture on "The Navigational (Magnetic) Compass as an Instrument of Precision," by Mr. M. B. Field.

**Electro-Harmonic Society.**—Friday, January 10th. At 8 p.m. At the Holborn Restaurant (Venetian Chamber). Smoking concert.

**Manchester Association of Engineers.**—Saturday, January 11th. At the Grand Hotel. At 6.30 p.m. Paper on "Iron and Steel Electric Furnaces," by Mr. J. Bibby.

## NOTES.

**The Coalition Government.**—We believe that all who are anxious that the hands of those who have to represent Great Britain at the Peace Conference should be strengthened, and that our Statesmen should know that the nation is solid behind them in the heavy and delicate work that lies before them, have hailed with satisfaction the success of the Coalition Government at the polls. The avowed object of Mr. Lloyd George and those prominently associated with him was to clear party squabbling from the political arena, especially during the period of reconstruction. Most of us had become utterly sick of the clogging of the wheels of reasonable and legitimate legislation by party discussions and differences. The party machine now lies broken beyond immediate repair. The new Parliament will have an opportunity of showing what it can do for the good of the nation as a whole before it again splits up, as, we suppose, it inevitably must sooner or later—being a human organisation, and one which can only be efficiently run if there is a strong opposition as a corrective force—into groups and parties. In the ELECTRICAL REVIEW of February 15th, 1918, we remarked: "If we have needed a coalition for securing unity in war, and require it for guaranteeing the interests of all in securing the right peace, we shall more than ever find it essential for securing unity and guaranteeing the interests of all in the period of reconstruction." In our issue of August 2nd, 1918, in referring to the deplorable skilled labour strike that had just ended, we said:—"There is unquestionably a need for a strong Government with the nation behind it, and if a Parliamentary Election is going to secure such for us the sooner it takes place the better. If there is a loose rein after the war, or if there are blunders due to vacillation, the way to ruin will be short and steep." The new Government is not yet formed; the new Parliament is only a few days old. But we suppose that it comes nearer than ever Parliament has done before to being a body wherein, comparatively speaking, "none were for a Party, and all were for the State." We venture no predictions, but the voting of the people of England, Scotland, and Wales fills us with confidence for the coming days, for there is obviously a general demand for stability and Peace at Home, and the forces that make for Bolshevism, though noisy, and to some extent dangerous if left uncontrolled, are unlikely to be able to summon a following of any proportions while the Government at the helm shows itself both strong and tactful.

**Lighting Regulations.**—Mr. H. H. Thompson, manager of the Kingsway Theatre, has been fined £5 at Bow Street for unlawfully lighting a number of electric lamps of 25 and 100 C.P. at the entrance of the building for the purpose of advertisement and display. The Magistrate, after inspection, held that the lights were in excess of what were necessary for mere safety. He said that the Advertisements Order was in force for effecting economy in coal consumption, and the matter must be judged from that standpoint.

**Electric Welding.**—In the *Journal* of the Engineers' Club of Philadelphia, Prof. Comfort A. Adams says, with reference to rigid *versus* non-rigid systems of welding, that the U.S. Shipping Board Sub-Committee on Research reported that the conclusion was that if two pieces of metal were allowed to lie loosely and free to move, they would warp and distort in their relative position during the process of welding; but if they were clamped rigidly, the stresses which were set up were taken up almost entirely by a slight giving of the weld, so that when the parts were released there was no tendency for them to spring out of shape, nor was there any apparent lack of strength which could be regained by supposedly releasing the strains by annealing. With reference to overhead work, the consensus of opinion was that, except for intermittent spots, overhead welds were extremely unreliable. It was difficult to deposit the metal at all without great fatigue on the part of the operator, and the quality of the work was markedly inferior. The conclusion had been come to that overhead welding should not be depended on at all, it was only suitable for temporary tacking. In connection with a certain welded ship, Prof. Adams gave figures, reduced to a ton basis, which had been worked out as to the probable cost of the steel hull. The cost was divided into two parts, namely, welded and other parts, and was considered a conservative estimate of the cost of preparing plates for welding and assembling. The total cost of labour, power, and electrodes, apart from the cost of steel itself, was $63.50 per ton of steel in the hull. In that ship there were only 2,300 tons of steel, instead of 2,800 tons, which would be used in the ordinary riveted ship. Reduced to the same basis of tonnage, the cost was only $52.50 per ton for the purpose of comparison. The cost of the riveted ship to-day was in the vicinity of $80 per ton. The average speed of welding was 5 ft. per hour, not allowing for the long waits of actual work; the amount of metal per running foot was 0.6 lb., and the current 150 amp. at 20 volts. The power was estimated to cost 3.6 cents per ft., bare electrodes 7.2 cents, and labour 13 cents. Total cost of weld per ft. was 23.8 cents. The costs were taken from English practice. The programme for permissible welding as outlined at Hog Island covered a total number of about 225,000 pieces, which it was estimated could be riveted at a cost of about $245,000, and welded for about $99,000, or approximately 60 per cent. of the cost of riveting. One reason why the completely welded ship was not being realised at the present time was the effect of crystallisation of the joints under vibration stresses. Most arc welds, although not all, were, relatively speaking, brittle, and ship designers and the classification societies were cautious and afraid of the brittle joint.

**Heat Radiation.**—In a letter in *Nature*, of December 26th, Dr. J. A. Harker gives particulars of some experiments which he made at the National Physical Laboratory in connection with some work on radiation from surfaces, which show that the colour of a hot surface at relatively low temperature has very little influence on the amount of radiation leaving it.

In a series of experiments the sides of a thin cubical metal canister were painted in panels of varying colour, the interior of the cube being filled with rapidly stirred oil electrically heated. The amount of pure radiation leaving each kind of surface at a series of steady temperatures up to about 200 deg. C. was compared with that coming at the same temperature from a "black body" constituted by a re-entrant tube with appropriate diaphragms. The exterior of the tube was washed by the hot oil. For temperature differences in the region of 100 deg. C. it was found that:—

1. A bright surface of ordinary tin-plate only gave off an amount of radiation equal to 5-10 per cent. of that from a "black body." The quality of the optical perfection of the surface was of little importance so long as it was bright. A metal surface treated with galvanit of various kinds showed effects of the same order as tin-plate. Burnished copper well cleaned with metal polish gave a lower intrinsic radiation than tin.

2. A coat of almost any paint, regardless of colour, brings the true radiation up to from 80-90 per cent. of that of a "black body," and a quite thin layer of paper varnish or of celluloid varnish, so thin and transparent as to be almost imperceptible to the eye, applied over the bright metal, has almost the same effect.

3. A layer of tissue-paper or wallpaper pasted over the bright surface, or a coating of whitening or limewash, shows the same kind of effect in restoring practically the full radiation so long as the coating is thin.

4. If the surface of the cube be metallised with aluminium paint, the pure radiation is reduced to from 45-55 per cent. of that of a "black body." Much depends, however, on the kind of vehicle used for the aluminium, and different samples of aluminium paint, though giving results similar in appearance to the eye, differ considerably in the effects produced. Bronzing and such-like processes produce intermediate effects.

In some later experiments, with which Mr. Ezer Griffiths was associated, a study was made of the total heat leaving surfaces, with the view of obtaining some data as to the relative effects of conduction, convection, and radiation in ordinary still air. From these experiments it would appear that in the case of low-pressure steam radiators in the region of 100 deg. C., almost exactly half the heat leaving the vertical surfaces, if these are of an ordinary character or painted in the usual manner, consists of pure radiation, the remainder being the combined effect of conduction and convection. Therefore, if, as is a very common practice, the radiators be metallised by painting with aluminium paint, the amount of heat reaching the middle of a room warmed by such radiators will be lowered to half, or double the amount of heating surface will be required to produce the same radiation effect as if the surface were black or of bare metallic iron.

**Reconstruction Lectures and Conferences.**—The following arrangements have been made by the Industrial Reconstruction Council:—

SADDLERS' HALL, LECTURES, WEDNESDAYS, AT 4.30 P.M.:—

January 8th.—"Industrial Unity," by Rt. Hon. G. H. Roberts, M.P.
January 22nd.—"Industrial Reconstruction in Government Departments," by Judge Edward Parry.
February 5th.—"The Industrial Awakening," by Mr. E. J. P. Benn.
February 19th.—"The Responsibility of Trade Unions in Relation to Industry," by Rt. Hon. J. R. Clynes, M.P.
March 5th.—"Industrial Changes Caused by the War," by Prof. A. W. Kirkaldy.
March 19th.—"The Functions of Government in Relation to Education," by Rt. Hon. H. A. L. Fisher, M.P.

HALL OF INSTITUTE OF JOURNALISTS, CONFERENCES, TUESDAYS, AT 6 P.M.:—

January 14th.—"Reconstruction or Restoration," by Major H. J. Gillespie.
January 28th.—"The Workers' Interest in Costing," by Mr. M. Webster Jenkinson.
February 11th.—"The Place of the Merchant in British Industry," by Sir Charles McLeod.
February 25th.—"Welfare Work," by Miss Newcomb.
March 11th.—"Labour Conditions in Relation to Future Industrial Prosperity," by Captain J. O'Grady, M.P.
March 25th.—"Industrial and Educational Reconstruction," by Mr. F. W. Sanderson.

**Ticker and Telephone.**—In an interesting paper read by M. Gondet, before the Société Française de Physique, allusion is made to the possible applications of the ticker employed in wireless telegraphy, the function of which is to produce interruptions of current of a frequency capable of producing a musical note. A ticker of this type, used in conjunction with a telephone, could often be employed in practice, instead of a galvanometer, as a convenient means of detecting small continuous currents of the order of 1 microampere upwards. A sketch is given of a Wheatstone bridge arrangement using the ticker and telephone which is recommended for industrial work.

**Volunteer Notes.**—ROYAL ENGINEERS VOLUNTEERS, LONDON ARMY TROOPS COMPANIES.—Headquarters: Balderton Street, Oxford Street, W. 1.

Regimental Orders No. 1, by Lieut.-Colonel C. B. Clay, V.D., Commanding, Monday, January 6th, to Saturday, January 11th.—Drills as usual.

C. HIGGINS, *Capt.* R.E., *Adjutant.*

**Engineers in the Académie des Sciences.**—The Academy has elected M. Rateau to membership of the new Division of Applications of Science to Industry. M. Leblanc was the first member elected.

**Educational.** — UNIVERSITY OF SHEFFIELD. — Some particulars are given in the *Sheffield Independent* of the remarkable work that has been done by the University during the war. In addition to the manufacture of gauges and shells in the Engineering Department, the production of cupro-nickel was developed experimentally by the Non-ferrous and Electro-metallurgical Departments, with most important results; the total output was 1,354 tons.

The Electrical Engineering Department, with the local staff of the Aeronautical Inspection Department, has tested and reported upon 27 samples of magnetic steels, 144 standard magnets, 150 tests on non-magnetic (nickel steel) steels, and 35,000 magnets. Since December, 1916, the staff of the Applied Chemistry Department has been engaged on investigations on carbonisation of coal.

In the Electro-metallurgical Section, wounded officers, previously trained in non-ferrous metallurgy, are employed on work in connection with the engineering repair shops in France—building up worn-out parts or rejected material by the electro-deposition of thinner or thicker films of various metals to restore them to normal dimensions.

The University has taken a prominent part in the foundation of the Officers' University Training Classes, a movement which promises to be of extreme value in enabling the wounded officer to take a useful place in the industrial development of the nation after the war. The Sheffield University was the first to establish a training course. Up to the present, 59 wounded officers have attended the course in the Faculty of Engineering, and 134 in the Faculty of Metallurgy.

During 1917 the staff of the Electrical Department advised and assisted the members of the local Anti-aircraft Defence Corps in the construction of frame-work required for the training of officers and men in the use of appliances for the location of aircraft.

These are only a few of the many important services rendered by the University to the State and to the city.

**Inquiry.**—A correspondent wants the name of a firm that will undertake the repair of various small electrical meters and measuring instruments.

**Socials.**—A very successful ball was held on December 20th at The Barracks, Grove Park, Kent, to celebrate the end of the Great War. It was arranged exclusively for "lads and lasses" of the Transport and Workshops Company at No. 1 Reserve, M.T. Depôt, A.S.C., Grove Park, by kind permission of Lieut.-Col. P. H. Kitson, A.S.C., Commanding Depôt, and Capt. C. Crowther, A.S.C., Commanding Company. The hall was tastefully decorated under the supervision of Lieut. Cockerill. The electrical effects for the occasion were lent by the General Electric Co., Ltd.

The Bradford and Otley District Branch of the Engineering Foremen's Mutual Benefit Society held their annual social evening in the dining and recreation rooms attached to the works of Messrs. Thwaites Bros., Ltd., Bradford, last Saturday week. There were 170 members and guests present. At the whist drive which followed the repast the prizes were distributed by Mr. P. J. Pybus, of the Phœnix Dynamo Co., Ltd., who paid a handsome tribute to the manner in which foremen had performed their duties during the very difficult and strenuous war period. The evening's enjoyment was contributed to by musical friends, and the "annual" was a great success.

**The Cable Censorship Handicap.**—An actual example of the heavy handicap that is placed upon foreign trade transactions by the continuance of the cable censorship is given in the following letter, which appeared in the *Times* on Wednesday:—

Sir,—On the 16th inst. I chartered the ss. *Tatsua Maru*, then at Durban awaiting orders to load a cargo from British East Africa to Japan, at a freight of about £20,000. We immediately attempted to get a priority cablegram through to the captain, instructing him to proceed to his loading port on the British East African coast, but having received instructions to go on to Mauritius, in case no orders were waiting for him at Durban, he sailed from Durban on the 18th for Mauritius. We then cabled instructions to Mauritius, but, again through the delay on the cables, the captain found no orders waiting for him at Mauritius on his arrival there on the 24th-25th, and, on the 26th, still having no orders, he sailed for Colombo. The steamer is, therefore, now beyond recall, and cannot fulfil her charter from British East Africa, thus entailing a double loss to the trading community—namely, to the owners and the shippers of the cargo. It is taking quite seven or eight days for the delivery of commercial cables to South African ports and Mauritius, and another seven or eight days to get a reply, whilst to get a cable reply from Japan takes anything from three to four weeks. How can international trade be maintained under such disabilities?

DONALD MACLEOD.

Sussex House, 52, Leadenhall Street, E.C. 3
December 31st.

**Institution and Lecture Notes.—Institution of Electrical Engineers.**—The "Institution Notes" in the *Journal* for December announce that the Council has elected Mr. Percy R. Allen and Mr. Walter Judd to be Members of Council in place of the late Mr. J. O. Callender and Lieut. W. L. Preece; and Prof. A. E. Kennelly, D.Sc., of Harvard University, U.S.A., to be an Honorary Member of the Institution.

The President, having visited and addressed meetings at the British Territorial Centres, states that the action taken by the Council in the direction of improving the status of the former Local Sections has already proved most beneficial; the fundamental idea of the Council is that the Institution has no sections, but is one and undivided in whatever part of the country a meeting may be held, and it is clear that the steps taken to give effect to this idea are already meeting with a large measure of success.

The Council has decided to recognise the Electrical Power Engineers' Association as the protective Association for engineers qualified to hold a responsible position directly concerned with the production, transmission, distribution, or utilisation of electrical energy.

The expression "direct current" will in future be used in place of "continuous current" in all official publications of the Institution; this decision is in accordance with our own preference, which we have expressed on previous occasions and acted on when possible.

A list of the members of Committees appointed by the Council for 1918-19 is given in the *Journal*, as well as a list of representatives of the Institution on other bodies, the Roll of Honour, Military Honours Awarded, members on Military Service, and Promotions, Transfers, &c., of members on service.

At Swansea, on Saturday last, Mr. W. Burr, borough electrical engineer, delivered an illustrated lecture on medical electricity.

**Electrical Association of Australia.** — At Melbourne, on November 28th, Mr. M. C. Timms read a paper on "Submarine Cables."

**International Science.**—*The Times* of December 21st gave particulars of the new international organisation for the promotion and co-ordination of scientific and industrial research. The first Conference was held in London in October, at the instance of the Royal Society, and decided that it was desirable that the nations at war with the Central Powers should withdraw from the existing international conventions and establish new associations. The representatives of the United States recommended that "National Research Councils" should be formed in the different Allied countries, with constitutions similar to that of the U.S. National Research Council, and that from them should be formed an "International Research Council," in whose hands the whole work of international co-operation in science could be placed. This proposal was adopted at the meeting in Paris on November 26th, and an "Executive Committee" of five members was nominated, with an "Administrative Bureau" to be established in London. The president of the Committee is M. E. Picard, one of the permanent secretaries of the Académie des Sciences; the other members are: Dr. G. E. Hale (United States); Prof. Volterra (Italy); Major Lecointe (Belgium); and Prof. A. Schuster (Great Britain).

**Mine Signalling Patents.** — Patent Application No. 116,426, Automatic Telephone Manufacturing Co., Ltd., and Charles Remington, was recently opposed by the Sterling Telephone and Electric Co., Ltd., upon the grounds that the invention claimed therein has been claimed in their prior Patents Nos. 112,497 and 19,854 of 1914. The application in question discloses a mine signalling system in which several onsetters are enabled to indicate signals upon a single indicator before the engineman. One onsetter upon signalling monopolises the indicator to the exclusion of the other onsetters, who receive busy signals should they commence signalling, until the signal set up by the first onsetter has been cancelled by the engineman complying therewith. The Controller-General heard the contending parties in this matter on December 12th, Capt. Odell appearing for the opponents and Mr. Toulin for the applicants. The applicants contended that the inventions claimed in the opponents' patents were quite different from the invention described in the applicants' specification, and this view was upheld by the Controller, who decided to dismiss the application, with costs against the opponents.

**Appointments Vacant.**—Mechanician (£250 + £120) for the Post and Telegraph Department, Nigeria; mains engineer for the R.E. camp at Upton Lovell; cable jointer for the Rawtenstall Corporation. See our advertisement pages to-day.

**Investigating the Brazilian Machinery Market**—An investigator is shortly to be dispatched to Brazil to ascertain the conditions and prospects for the sale of British engineering products in that market. He will go on behalf of the Department of Overseas Trade and the British Engineers' Association, who are acting jointly

**Patent Office Library Closing Time.**—"Student" writing to the *Times* urges that the Patent Office Library should now revert to its pre-war hour of closing (10 p.m.), so as to give Naval and Army officers who are unable to pursue their studies during the daytime an opportunity for access to its extremely valuable collection of technical works. The present hour of closing is 5 p.m., and we hope that the authorities will seriously consider "Student's" suggestion.

**A Light-weight Battery.**—Mr. N. D. Sturges, of New York City, has produced a light-weight storage battery which meets the rigid requirements of the airplane designers. It is said to be the lightest battery ever manufactured for watt-hours per lb. of elements. According to *Indian Industries and Power*, the battery is capable of a steady output of 20 watt-hours per lb. of elements, which is claimed to exceed that of any other battery; and it is only half as heavy as the average automobile starting battery, which weighs about 80 lb. The over-all dimensions of the airplane battery are: Length 9¼ in., width 6¼ in., height 8¼ in. The plates are 1/16 in. in thickness, nine to a cell, and six cells to a battery, or a total of 54 plates. The battery has an output of 50 amperes at 12 volts for 30 minutes.

**The 47 Hour Week for Engineers.**—It is announced that the following arrangements have been made in connection with the introduction of the 47-hour week on January 1st, pending further discussion between the Employers' Federation and the Trade Unions:—

1. The day shift shall terminate at the present hour of stopping in each establishment, unless otherwise agreed between the firm and their men.
2. Where necessary, in order to make up 47 hours on account of a 12 o'clock Saturday, half an hour extra shall be worked on one evening of the week, unless otherwise arranged between the firm and their men on a 47-hour basis.
3. The rate of men whose normal working week of 58 hours is in excess of the normal district week—*e.g.*, 54—shall be enhanced as if they worked the normal district week.
4. Time rate per hour to be increased for day-shift men according to amount of reduction in hours.
5. Night-shift to be paid on enhanced day rate.
6. Night-shift hours to remain as at present, pending readjustment.
7. Premium bonus earnings shall be calculated on enhanced day-shift rate.
8. No change shall be made in piecework prices or list rates.

It is understood that the Clyde engineers voted by a majority against the 47-hour week. The Scottish Trade Union Congress has by a majority called for legislation for a 40-hours week, preferably five days of eight hours.

Grimsby engineering and allied trade workers downed tools on Wednesday as a protest against the 47-hours week having been brought into operation. According to Press reports the men object to dinner-time being the only break during the day's work.

According to the *Leeds Mercury*, a conference was held on Friday last between the Sheffield and District Engineers Employers' Association and representatives of all the local Unions parties to the joint recommendation of November 19th, to consider questions arising out of the application in the district of a 47-hour working week. An arrangement was arrived at under the terms of which, as from January 1st, the hours of the day-shift shall be as follows:—8 a.m. to 12.30 p.m., 1.30 p.m. to 5.30 p.m., Monday to Friday inclusive. Saturday, 7.30 a.m. to 12 p.m. Regarding the night-shift, it was arranged that this should commence at 5.30 p.m. and finish at 6 a.m., with breaks for meals as at present, this to be a temporary arrangement pending the holding of further conferences to discuss the question of night-shift and men working on the shift system.

Miners in the South Wales district are discussing the question of a six-hour day in the mines, and the local Federation is seeking an interview with the Prime Minister on this and other matters. The Cleveland miners have decided to bring the same point before the Miners' Federation; they also want income-tax exemption up to £200 a year for miners; the abolition of piece-work; increased old-age pensions, and a reduction of the age-limit to 60; also the early abolition of all female labour at the mines.

**A Diminutive Electric Motor.**—An electric motor of extremely small dimensions has appeared on the market, says the *Polytechnische Rundschau*, a supplement to *Elektrotechnische Rundschau*. The motor is enclosed in a shell of 3 cm. diameter and 4 cm. length and weighs 150 gm. The shaft is arranged so as to hold tools that are required by dentists and surgeons, but the device should be of great use for other purposes, such as boring small holes in metals and rare stones. The motor can be driven by direct or alternating current, and runs at a maximum speed of 5,000 R.P.M.

## OUR PERSONAL COLUMN.

***The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.***

**Central Station Officials.**—Rochdale Electricity Committee has recommended that the salary of Mr. F. H. RUDD, the manager of the electricity works, be increased by £50 per annum. He was appointed in August, 1917, at £400 a year, and in August last this was increased by £50, with a promise of a similar increase next August. In view of the extra work Mr. Rudd has performed the committee recommends that the increase should be given at once.

The *Australian Commonwealth Gazette* states that Mr. R. N. PARTINGTON, Deputy State Engineer, Electrical Engineer's Branch, has been appointed Deputy Chief Electrical Engineer at £700 per annum, and Mr. J. P. McGlinn, State Supervising Engineer, has been appointed Deputy State Engineer at £606 per annum.

Mr. F. BUCKLEY, general manager of the Wigan Corporation tramways, has been appointed general manager of the Bury Corporation tramways department. There were 42 applicants.

On the occasion of their silver wedding, Mr. J. MCLEAN, night shift foreman at the power house, Hamilton (tramways), and Mrs. McLean, were entertained by the power house employés and received presentations.

Mr. F. G. COOPER, electrical engineer of Colne, has accepted a position at Sheffield.

Mr. F. W. GREEN, shift engineer at the Bootle Corporation electricity works, was presented with a cut glass salad bowl and a pouch of tobacco on leaving to take up a similar position with the St. Helens Corporation. Mr. T. D. Clothier, borough electrical engineer, made the presentation.

Mr. F. W. KETLEY, who has resigned his position as manager of the Norwich Electric Tramways Co., has been presented by Norwich City Police Force with a silver cigarette box.

Mr. C. F. WELLS has resigned his position with the Swindon Corporation, having been appointed assistant engineer in the sales department of the Yorkshire Electric Power Co.

**General.**—Sir W. GUY GRANET has accepted a seat on the board of the County of London Electric Supply Co., Ltd.

Mr. J. K. MORRIS, of the Kentish Shipbuilding & Engineering Co., has been elected a director of the Whitstable Electric Light Co., Ltd.

On the occasion of the retirement of Mr. W. T. HODGKINS from the position of works manager at Faraday Works (Gent & Co., Ltd., Leicester) the whole of the works and office staff and employés presented him with a travelling case and a Swan fountain pen. Regret at his departure was given suitable expression to by some present who had known Mr. Hodgkins during his long period at the works, where he passed from the stage of apprenticeship to that of works manager.

On New Year's Day, at the works of Messrs. Everett, Edgcumbe & Co., Ltd., a presentation, in the form of a handsome case of pipes, was made to Mr. Browning, chief of test, whose subordinates desired to give expression to their high esteem. The Test constitutes a very important part of the well-known factory at Hendon, where Mr. Browning has for many years directed the activities of the testing staff. Suitable speeches were made by members of the Test, and by Mr. Browning in reply.

The *Manchester Guardian* says that the new managing director of the British Westinghouse Electric & Manufacturing Co., Col. LINCOLN CHANDLER, has resigned his position at Trafford Park owing to failing health. Col. Chandler is a director of the Metropolitan Carriage, Wagon & Finance Co., and he has been the representative on the British Westinghouse board of the Metropolitan and Vickers' interests. Captain Hilton, of the same group, has taken over the managing directorship at Trafford Park. Major Chandler, son of Col. Lincoln Chandler, remains as the new joint secretary of the British Westinghouse Co.

Mr. CECIL LEIGH, F.I.C., for many years chief chemist of the Birmingham Metal & Munitions Co., Ltd., has been appointed general manager of Messrs. Thermit, Ltd.

Mr. R. W. DALTON, our Trade Commissioner in New Zealand, is beginning his tour of the provincial industrial centres. He will attend a number of Chambers of Commerce, starting at Norwich on January 7th and 8th. Bristol, Newport, Swansea, and Birmingham will follow, after which he will go to Lancashire, Ireland, and Scotland.

The Metallic Electrical Engineering Co., Ltd., of Birmingham, desire to inform the trade that Mr. W. T. BOWER is not now acting on their behalf.

**New Year Honours.**—In the New Year Honours List we observe that Mr. PERCY W. L. ASHLEY, Assistant Secretary, Department of Industries and Manufactures, Board of Trade, is appointed a C.B. (Civil Division). Mr. EDWARD RAVEN, Assistant Secretary to the G.P.O., receives a similar honour. Mr. JAMES FRASER, M.Inst.C.E., Chief Commissioner for Railway and Tramways, New South Wales, appears in the Colonial Office List with the appointment of C.M.G., as does also Mr. W. R. MORRIS, I.S.O. Secretary, Post and Telegraph Department, New Zealand.

**Roll of Honour.**—Lance-Corporal L. A. KNIGHT, S. Wales Borderers, who has died in hospital at Rouen from wounds received in action, was with the St. Helens Cable & Rubber Co., Ltd., Warrington.

Second Air Mechanic G. PENKETH, R.A.F., who has died from influenza in France, was an armature winder with Messrs. J. P. Hall & Co., Ltd., Oldham.

Lieutenant G. T. LYALL, Canadian Home Army, who has been awarded the Victoria Cross for most conspicuous bravery and skilful leading during the operations north of Cambrai on September 27th, is 26 years of age, and a native of Manchester. He was trained as a naval engineer, but owing to deafness left the service, and in 1912 went out to Canada as an electrical engineer.

Lance-Corporal H. STANLEY, R.E., who was employed in the Bradford Post Office engineering department, has been awarded the Military Medal.

**Obituary.**—MR. STEPHEN SELLON.—We regret to learn that the death occurred suddenly on December 22nd, from heart failure, of Mr. Stephen Prescott White D'Alte Sellon, M.Inst.C.E., the well-known consulting engineer, of Westminster. In the years of his engineering training he was brought into contact with marine and railway engineering and main drainage work, but about 35 years ago he began to take an interest in electric tramway and light railway work, and this interest extended to several practical schemes, and was continued in his capacity as a consulting engineer. Some of his early operations in this connection included the first piece of electric trolley line at Leeds; later he was concerned with the manufacture, by one of the principal electrical engineering companies of the time, of electric

traction material. He also acted as engineer to the British Electric Traction Co., Ltd., for some years. He was selected at different periods to serve on Government commissions such as those investigating Irish industrial developments and tramway traffic questions. Several years ago he gave evidence before a Parliamentary Committee regarding the public economies that would result from a policy of co-operation between gas and electric lighting undertakings.

MR. E. CUNLIFFE OWEN.—We learn with regret of the death of Mr. Edward Cunliffe Owen, C.M.G., which has occurred at Loughborough, at the age of 61 years, after a very long illness. Mr. Cunliffe Owen was called to the Bar in 1880, but he will be remembered in electrical circles by reason of his long connection with the Metropolitan Electric Supply Co., of which he was secretary, and the active part that he played in some of the electrical exhibitions held in London not very many years ago.

SIR J. BAXTER ELLIS.—There has passed away at Newcastle-upon-Tyne Sir Joseph Baxter Ellis, who was a member of the City Council there for some 38 years, was the first mayor of the city, and was brought into touch with some of our readers during the five years of his chairmanship of the Tramways Committee. He was 76 years of age.

MR. J. HUBERT DAVIES.—We regret to learn that Mr. J. Hubert Davies, chairman of Messrs. Hubert Davies & Co., Ltd., passed away at Capetown on December 12th. Mr. Davies, who was only 61 years of age, and was an M.I.E.E., M.I.M.E., A.M.I.C.E., &c., was in his early days a designer in the offices of Woodhouse & Rawson. About thirty years ago he went out to South Africa for Messrs. Farrar Bros. in connection with certain electrical mining installation, and thenceforth South Africa became his home. At first he acted in a consulting engineering capacity, but later he turned his attention to the commercial side, and entered into partnership with Mr. Spain, forming the firm which became so well known, and which was subsequently converted into a limited company. The concern carried out public and private electrical and engineering contracts of considerable magnitude, and the company had headquarters at Johannesburg, with branch offices in London and at Cape Town, Durban, and Salisbury. The strain of a very busy and enterprising life told upon him to such an extent that his health had been failing for a number of years, and we understand that the end when it came in December was not a surprise to those in his immediate circle.

MR. THOMAS MANGNALL.—The death occurred on December 19th, at the age of 68 years, of Mr. Thomas Mangnall, of Manchester, for twenty years secretary of Electromotors, Ltd., Openshaw.

MR. A. E. GREVILLE.—The *Times* records the death, at the age of 72 years, of Mr. A. E. Greville, an Isle of Wight solicitor, who followed science as a hobby, and is described as "the inventor of the Greville electro-thermic treatment which is still in use at Harrogate, Bath, and Buxton."

**Will.**—The late Mr. J. F. G. PARSONS, R.F.A., who was killed in April last, director of Messrs. C. A. Parsons & Co., and the only son of Sir C. A. Parsons, left £11,418 gross.

## NEW COMPANIES REGISTERED.

**Homo, Ltd.** (152,306).—Private company. Registered December 19th. Capital, £2,000 in £1 shares. Electrical and general engineers, manufacturers, importers, exporters of and dealers in machinery and tools, &c. The subscribers (each with one share) are:—A. Rist, 53, Cecile Park, Crouch End, N.8, engineer; A. C. Doo, 33, Ferme Park Road, N.4, engineer. First directors: A. Rist and A. C. Doo. Registered office: 24-27, Rood Lane, E.C.3.

**Integral Oxygen Co., Ltd.** (152,332).—Private company. Registered December 20th. Capital, £16,000 in 10,000 non-cum. pref. shares of £1, and 12,000 ord. shares of 10s. each. To acquire the interest of Arthur Lyon & Wrench, Ltd., in their agency arrangement with the International Oxygen Co. of the U.S.A., to take a licence from the American company to this company to manufacture and sell certain patent apparatus, to acquire any interest in inventions relating to electrolytic apparatus for the production of oxygen and hydrogen. The subscribers (each with one pref. share) are:—T. L. Reed Cooper, 10, Gordon Road, Ealing, electrical engineer; E. L. W. Byrne, 29, Gainsborough Road, Bedford Park, W.4, engineer. First directors: H. T. Wrench, E. L. W. Byrne, T. L. Reed Cooper, and a nominee of the International Oxygen Co. of U.S.A. Manager: E. L. W. Byrne. Registered office: 38, Victoria Street, S.W.

**British Overseas Supplies, Ltd.** (152,347).—Private company. Registered December 21st. Capital, £20,000 in £1 shares. Importers, exporters, merchants, and factors of goods and merchandise of all kinds, &c. The subscribers (each with one share) are:—F. J. Robinson, 91, Holyhead Road, Coventry, engineer's sales manager; W. Seal, 67, Wentworth Road, Harborne, Birmingham, electrical and mechanical engineer. First directors: F. J. Robinson, W. Seal, and S. T. Peirson. Solicitors: Browetts, Coventry.

**Liverpool Copper Wharf Co., Ltd.** (152,354).—Private company. Registered December 21st. Capital, £2,500 in £1 shares. To take over the business of James Lewis & Son's Copper Wharf Co., Ltd., hitherto carried on in Liverpool (now in liquidation), and to carry on the business of wharfingers of copper, silver, and other ores, precipitate regulus matte, and other metalliferous products, &c. The first subscribers (each with one share) are:—A. H. Lewis, Danesfield, Marlow, Bucks., gentleman; G. D. Lewis, 5, Fenwick Street, Liverpool, merchant. First directors: A. H. Lewis, G. D. Lewis, and J. A. Wilson. Registered office: 5, Fenwick Street, Liverpool.

**Calworth, Ltd.** (152,394).—Private company. Registered December 24th. Capital, £1,000 in £1 shares. Manufacturers of and dealers in electrical and other accessories, instruments, appliances, and novelties, &c. The subscribers (each with one share) are:—H. C. Caldecourt, 18, Brookfield, West Hill, Highgate, N.6, pianoforte factor; A. V. Butterworth, 13, Allison Road, Acton, W.3, engineer. The first directors are: H. C. Caldecourt and A. V. Butterworth. Acting secretary: A. H. Howard. Solicitor: B. F. Browne, 17, Hart Street, Bloomsbury, W.C.

**International Electrical & Mechanical Supplies Co., Ltd.** (152,370).—Private company. Registered December 23rd. Capital, £500 in £1 shares. To carry on in Birmingham or elsewhere the business of manufacturers of, dealers in, and lettors to hire, repairers, cleaners, storers, and factors of electrical and mechanical contrivances, machinery and accessories, and lubricants, cements, solutions, and enamels for use therewith, manufacturers of articles in wood, metal, composition, cement, china, plaster, celluloid, pulp, paper, and cardboard, builders and owners of motor cars, aeroplanes, ships, and vessels and their fittings, &c. The subscribers (each with one share) are:—G. W. Griffith, 37, Soho Road, Handsworth, Birmingham, accountant; A. J. Lytheer, 66, Newman Road, Erdington, engineer. The subscribers are to appoint the first directors. Registered office: 40, Herald Chambers, Martineau Street, Birmingham.

**John Thompson (Dudley), Ltd.** (152,333).—Private company. Registered December 20th. Capital, £100,000 in £1 shares. Engineers, founders, smiths, machinists, inventors, designers, and manufacturers of boilers of all kinds and parts thereof, manufacturers of roofing, bridges, tanks, cisterns, galvanising baths, iron and steel canal or other boats, creosoting cylinders, forgings, tubes, pipes, requisities for railways and tramways, sporting and athletic goods, anti-fouling compositions, soaps, fats, and oils, &c. The subscribers (each with one share) are:—J. Thompson, Ettingshall, Wolverhampton, engineer; A. E. Thompson, Ettingshall, Wolverhampton, engineer. Permanent governing directors: J. Thompson, A. E. Thompson, W. J. Thompson, and S. J. Thompson.

**John Thompson (Motor Pressings), Ltd.** (152,334).—Private company. Registered December 20th. Capital, £100,000 in £1 shares. Objects: As title. Power is also taken to carry on various businesses similar to John Thompson (Dudley), Ltd. The subscribers and directors are the same as in the last-named company (q.v.).

**John Thompson (Wolverhampton), Ltd.** (152,345).—Private company. Registered December 20th. Capital, £230,000 in £1 shares. Objects and other particulars similar to John Thompson (Dudley), Ltd. (q.v.)

**Leonard G. Tate & Co., Ltd.** (152,372).—Private company. Registered December 23rd. Capital, £1,000 in £1 shares. Electrical, mechanical, and hydraulic engineers and contractors, brass founders, metal workers, tool makers, mechanists, metallurgists, &c. The subscribers (each with one share) are:—R. L. Tate, Sylata, North Park Gardens, Gerrards Cross, underwriter; L. G. Tate, Vineyard House, Richmond, Surrey, electrical engineer; A. E. Catchpole, 17, Broxham Road, West Norwood, electrical engineer. First directors: R. L. Tate and A. E. Catchpole. Registered office: 20, Bucklersbury, E.C.

## CITY NOTES.

**French Companies.**

*The Société Industrielle des Téléphones* reports that despite many difficulties encountered in procuring coal and other raw materials, a further increase was made in the number of manufactures produced in 1917-18. An extension of the telephone works in the Rue des Entrepreneurs was made, and further expansion was projected as soon as circumstances would permit. Owing to the exceptional depreciation of the machinery and plant—through intense working, it was necessary to write off £100,000, leaving net profits of £168,000. The sum of £52,000 has been placed to the reserve of the contingency fund, and a dividend declared at the rate of £1 12s. per share.

The directors of *The Electro-Métallurgie de Dives*, reporting on the year ended on June 30th, 1918, state that business with private customers remained very limited, the company's activity having continued to apply to manufactures for the national defence. New manufactures were undertaken at the instance of the Army authorities, including the production of tubes of duralumin, which was the property of one of the company's subsidiaries, but this branch would be discontinued as soon as the Government demand came to an end. Including £9,800 brought forward from 1916-17 the accounts show net profits of £178,000, and a dividend at the rate of £2 8s. per share has been declared. The reserve fund has been increased by £40,000 to £280,000, and the sum of £29,000 has been carried forward to 1918-19.

The report of the *Compagnie Générale d'Electricité* for 1917-18 states that all the manufacturing works suffered from the restrictions and the transport difficulties, and two works on military contracts were stopped at the request of the Ministry of Armaments. The liberation of Lille revealed the fact that the important Thumesnil works had been completely damaged and pillaged by the enemy, and the network of the Amiens Electricity Co. also was greatly damaged. As net profits the accounts indicate the sum of £192,000, as compared with £162,000 in 1916-17, and the dividend is at the rate of £2 per share on the whole of the share capital, whereas in the previous year the 50,000 old shares received £2 per share and the new shares £1. It is now proposed to increase the capital from £1,400,000 to £2,000,000.

**Edison Swan Electric Co., Ltd.**

The annual meeting was held on Monday at Winchester House, E.C. Mr. C. J. Ford, who presided, said that the gross profit for the year was over £100,000 in excess of that of the previous twelve months. The net profit, after allowing for the usual charges, was in excess of that earned for many years past, and amounted to £130,000. Unless the additional capital which was provided by the issue of preference shares had been available, such results would not have been possible. That achievement had been augmented by the gradual improvement of the company's plant and organisation. The negotiations with the Revenue authorities relating to the excess profits duty had been of a protracted nature, and had the original claim not been greatly modified there would have been no possible chance of the directors being in a position to recommend the payment of a dividend on the ordinary shares. As to the future prospects of the company, now that peace had come, all they asked was to be allowed to carry on their business in their own way, free from any

interference or control by Government departments. Manufacturers had patiently submitted to all manner of petty and annoying restrictions and interference by officials, who in most instances had previously had no commercial training, without complaint, feeling that in calmly submitting they were doing their bit and helping to win the war, and as far as that company was concerned, they had placed the whole of their resources at the disposal of the country. It was to be hoped that the Government would find some means of raising revenue other than the present excess profits duty, or that in any event the tax would be very substantially reduced, as such a tax was a serious deterrent to industrial development. If an arrangement could be come to under which shareholders should receive, first a reasonable return upon their capital, and, after fair reserves were provided, the balance went to the Government, it would be a far more equitable arrangement than the present. If this country was to keep its place in the commercial world, large sums would be required for new industries, and if the present ratio of excess profits tax, or even anything like it, was to remain in force, new enterprises would be strangled in their inception—in fact, he did not think the money would be forthcoming to give effect to them. An equally important question was the dumping in this country of foreign goods to be sold here at prices in most cases below that at which they were produced. Before the war that process particularly affected the electrical industry, but reading between the lines from statements which had been made by responsible Ministers, it seemed as if at last the Government had become alive to the importance of the question, and he thought that the shareholders would agree that some form of modified tariff was necessary and should be one of the first measures of the new Parliament. Against that, however, he might say that quite recently an inquiry had been sent out by one of the departments of the Board of Trade to the electric lamp manufacturers of this country, asking if there was any immediate prospect of the importation of smaller candle-power lamps in order to save electric current, and suggesting that these should be obtained from Holland as the seas were now open. That was not very encouraging or promising. English lamp manufacturers were perfectly able to make smaller candle-power lamps, and no doubt they would have done so long before this, except for the fact that the whole of their lamp output was under the control of the Government, and a very large proportion of their production was requisitioned by the Government. He mentioned that fact in order that shareholders might be aware of the treatment which the electrical industry, and probably many other industries, were likely to receive at the hands of certain Government departments unless the interests affected took a strong stand. The board had in view a general policy of expansion, feeling, as they did that in the near future if a company like that intended to hold its own it must be in a position to supply direct from its own factories practically every class of electrical goods from the smallest to the largest. That would necessitate the employment of further capital, and it was therefore the intention of the directors to make a further issue at an early date. In connection with their schemes of expansion it would interest them to hear that the directors had practically concluded negotiations for obtaining a large interest in a well-known and old-established firm of cable and electrical wire manufacturers, and in view of the more than probability of the nationalisation of the railways of this country, and the further probability that if this came about, a great impetus would be given to the electrification of the existing lines, they were hoping that, apart from the participation in what was already a profitable business, their association with the firm in question would prove beneficial to the company. They were also carrying on negotiations which, if successful, would give them an important interest in the manufacture of all classes of heavy electrical machinery. His colleague, Mr. Gimingham, was shortly proceeding to the United States for the purpose of negotiating terms of manufacture and sale by the company of a well-known electrical contrivance for which they hoped to obtain a large sale. Having referred to the extensions which the company was carrying out at Ponders End, the chairman concluded by paying a tribute to Mr. Hunter and the staff generally for the zealous way in which they had conducted the affairs of the company during the past year, and which had contributed to the satisfactory balance sheet they were able to present.

Mr. E. B. Ellice-Clark, in seconding the motion, endorsed the remarks of the chairman regarding the services of Mr. Hunter and the staff, and said that the work of Mr. Ford and the other directors also deserved special mention.

The report was adopted.

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**Alldays & Onions Pneumatic Engineering Co., Ltd.**—The accounts for 1916, 1917, and 1918 cannot yet be presented. For the year ended August 3rd last a further interim dividend at the rate of 7½ per cent. (making 10 per cent. per annum) is recommended; also, a further interim participating dividend on the 6 per cent. "B" cum. pref. shares at the rate of 1 per cent. (making 7 per cent. for the year). No further dividend in respect of the last financial year is recommended. The name of the company is shortly to be changed to Alldays & Onions, Ltd.

**Cordoba Light & Power Co., Ltd.**—Notwithstanding the strike of the tramway employés, there was an improvement in the results during the year to September 30th, 1918, of £32,068. This has resulted in a profit of £14,317 after meeting interest on the debenture stock and promissory notes, as compared with a loss of £17,721. The improved result is due in part to the extension of the electric supply business, but chiefly to the increased supply of water in the San Roque dam and the corresponding reduction in steam operation. But for the strike of the tramway employés the improvement would have been more marked. According to the *Financial Times*, it has been found necessary to postpone the issue of the annual report until it will include the accounts up to March, 1919.

**West Kootenay Power & Light Co.**—Year ended August 31st, gross receipts, $614,819; operating expenses, $181,891; net balance, $432,927. Dividends 7 per cent. on preferred and 8 per cent. on the common stock; $93,274 put to plant depreciation reserve. A meeting of shareholders last July increased the authorised capital stock from $2,500,000 to $5,500,000.

**Humphrey Pump Co., Ltd.**—The directors' report for the year mentions a continuance of adverse conditions due to the war. The financial results, although showing a small loss, are substantially better than those of the previous year. In view of the exceptional circumstances the directors have not drawn their fees.

**Stock Exchange Notice.**—Dealings in the following have been approved by the Treasury:—North Metropolitan Electric Power Supply Co., £250,000 6 per cent. cumulative preference shares of £1 each, Nos. 349,981 to 599,980, and £9,980 6 per cent. cumulative preference stock.

**Cork Electric Tramways and Lighting Co., Ltd.**—According to the *Financial Times*, payment of dividend on the preference shares will be postponed until completion of 1918 accounts.

**Manila Electric Railroad & Lighting Corporation.**—Dividend of 1¼ per cent. for the quarter to December 31st on the common capital stock.

**Yates & Thom, Ltd.**—Dividend of 7½ per cent. on the ordinary shares.

**Lima Light, Power & Tramways Co.**—Dividend 1½ per cent.

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## STOCKS AND SHARES.

NEW YEAR'S EVE, 1918.

JUST at the end of last year, 1917, appeared the interim report of the Coal Conservation Sub-Committee on the supply of electric power in Great Britain. Sweeping suggestions were made by the Committee for the amalgamation of authorities, and it was estimated that a saving of 100 million pounds in cash and 55 million tons of coal could be effected under the scheme proposed. From the point of view of the Stock Exchange market, these suggestions have had no effect whatever. They were too large for imagination to grasp during the war period, and it was felt that nothing practical was likely to be put into operation until Peace had been signed and the country had settled down again. Still, the Committee's first report has remained steadily in view, and has been supplemented by others which tend to bring the scheme into a nearer focus. The new Parliament may be called upon to deal before very long with the whole question from a national standpoint, and 1919 may see developments of the greatest interest to all those concerned in the subject.

Throughout the greater part of the year the market for electricity supply shares has been quiet and dull, but as the blessed figure of Peace came more clearly into the picture, there was a greater disposition to pick up shares, and prices advanced substantially. The railway stocks have been swayed on the one hand by labour troubles, and on the other by the prospects of nationalisation. Both these factors have played more or less indirectly upon the Undergrounds, though they have had a material influence over quotations of other railway stocks. In the Telegraph market a steady improvement has taken place, and, with the further rise in the Income Tax, attention has been more and more directed to stocks and shares upon which the dividends are paid tax free. In the foreign group, Mexicans have provided the most lively features. Prices have been run up and down, according to the hopes and fears as to settlement in the country; but on balance, the former have greatly prevailed, and Mexico Tramway 5 per cent. Bonds, which were 27½ a year ago, are now all but 40 points higher, while Mexican Light and Power Preferred shares, which were 29, have added 20 points to their price in the interval. The Anglo-Argentine Tramways group is also decidedly better, and British Columbia Electric stocks, which gave way heavily during 1917, have more than recovered their losses, the Deferred stock, which was 28 a year ago, now being 17 points up. Amongst Manufacturing shares, various schemes of capital rearrangement and bonus distributions of shares have taken place, with the result that prices stand considerably higher, actually, after making the necessary allowances. We append a

few of the principal changes throughout the year in the various markets dealt with in these notes :—

HOME ELECTRICITY COMPANIES.

| Stocks or Shares. | Dec. 31st, 1917. | Dec. 31st, 1918. | Rise or fall. | Ordinary Shares. | Dec. 31st, 1917. | Dec. 31st, 1918. | Rise or fall. |
|---|---|---|---|---|---|---|---|
| Brompton .. | 6¼ | 7¼ | + 1 | London .. | 1 | 1⅛ | + ⅛ |
| Charing Cross .. | 4 | 3⅞ | — ⅛ | Metropolitan .. | 3½ | 3 | — ½ |
| Chelsea .. .. | 3⅞ | 4 | + 1⅛ | St. James' .. | 7 | 7½ | + ½ |
| City of London .. | 13½ | 13 | — ½ | South London .. | 3 | 3 | — |
| County of London | 11 | 11½ | + ½ | Westminster .. | 6⅞ | 7⅛ | + ¼ |
| Kensington .. | 5⅞ | 5¼ | + ⅜ | | | | |

TELEGRAPHS AND TELEPHONES.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Ang.-Am. Pref. .. | 95½ | 99 | + 3½ | Indo-European .. | 52½ | 58½ | +6 |
| Cuba Submarine | 9½ | 10½ | + 1 | Marconi .. .. | 3⅝ | 4⅞ | +1⅛ |
| E. Extension | 15 | 15⅜ | + ⅜ | United R. Plate. | 6½ | 7⅝ | +1⅛ |
| E. Telegraph .. | 150½ | 157½ | + 7 | W. India & Pan. | 1 | 1⅛ | + ⅛ |
| Globe Tel. Ord. .. | 12⅞ | 14⅛ | + 1¼ | Western Teleg. .. | 15½ | 16½ | +1 |
| Great Northern .. | 36 | 33 | — 3 | | | | |

HOME RAILS.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Cen. Lon. Assen. | 60½ | 65½ | + 5 | Under. Ord. .. | 1⅜ | 3⅜ | + 1⅞ |
| Metropolitan .. | 22½ | 31½ | + 9 | do. "A" .. | 5/- | 8/9 | + 3/9 |
| Met. District .. | 16 | 26 | +10 | do. Income .. | 81 | 92½ | +11½ |

FOREIGN TRAMS., &c.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A. Arg. Tr. 1st Pref. | 2½ | 4 | +1½ | Mex. Trams. 1st | 27½ | 67 | +39½ |
| Brazil Traction .. | 45 | 57 | +12 | Mex. Light Com. | 17½ | 38 | +20½ |
| B. Col. Elec. Pref. | 42½ | 67½ | +25 | do. Pref. .. | 29 | 49 | +20 |
| do. Preferred .. | 30 | 50 | +20 | do. 1st .. .. | 32½ | 70 | +37½ |

MANUFACTURING.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Babcock & Wilcox | 3⅝ | 3¾ | + ⅛ | Elec. Construct. .. | 1¼ | 1½ | + ¼ |
| Brit. Aluminium | 1⅛ | 1⅛ | + ⅛ | Gen. Electric .. | 19½ | 17½ | — 2 |
| B. West. Pref. .. | 2⅞ | 2⅞ | — ⅛ | Henleys .. .. | 16½ | 9½ | + ⅝ |
| Callenders .. | 14½ | 10½ | — 4 | India-Rubber .. | 14½ | 17 | +2½ |
| Castner-Kellner .. | 8⅛ | 8 | — ⅛ | Telegraph Con. .. | 41½ | 48 | +6½ |

After-war problems there will no doubt be many during the coming year, as the country changes over from war conditions to those of peace. There should be, however, wide scope for expansion in most industrial directions, and the expectation that electrical undertakings will take a full share in these developments lends sincerity to the offer of all good wishes for a very Prosperous New Year.

## SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

| | Dividend 1916. | Dividend 1917. | Price Dec. 31, 1918. | Rise or fall. | Yield p.c. |
|---|---|---|---|---|---|
| Brompton Ordinary .. .. .. | 9 | 10 | 7½ | — | £6 18 0 |
| Charing Cross Ordinary .. .. | 5 | 4 | 3⅝ | + ⅛ | 5 10 4 |
| do. do. do. 4½ Pref... | 4½ | 4½ | 3⅝ | — | 6 13 4 |
| Chelsea .. .. .. .. .. | 3 | 3 | 4 | — | 6 5 4 |
| City of London .. .. .. | 8 | 8 | 13 | — | 6 3 1 |
| do. do. 6 per cent. Pref. .. | 6 | 6 | 10½ | — | 5 18 5 |
| County of London .. .. .. | 7 | 7 | 11½ | — | 6 5 7 |
| do. do. 6 per cent. Pref. | 6 | 6 | 10½ | — | 5 18 5 |
| Kensington Ordinary .. .. | 6 | 7 | 5¼ | — | 5 19 2 |
| London Electric .. .. .. | Nil | Nil | 1⅜ | + ⅛ | Nil |
| do. do. 6 per cent. Pref... | 4 | 5 | 4 | — | 6 5 0 |
| Metropolitan .. .. .. .. | 3 | 4 | 3 | — ⅛ | 6 13 4 |
| do. 4½ per cent. Pref. .. | 4½ | 4½ | 3⅛xd | — | 6 18 6 |
| St. James' and Pall Mall .. | 8 | 9 | 7½ | — | 6 6 4 |
| South London .. .. .. | 3 | 3 | 3 | — | 6 13 4 |
| South Metropolitan Pref. .. | 7 | 7 | 20/6 | — | 6 16 7 |
| Westminster Ordinary .. .. | 7 | 9 | 7½ | + ⅛ | 6 4 4 |

TELEGRAPHS AND TELEPHONES.

| | | | | | |
|---|---|---|---|---|---|
| Anglo-Am. Tel. Pref. .. .. | 6 | 6 | 99 | — | 6 1 0 |
| do. Def. .. .. | 1½ | 1½ | 23½ | — | 6 9 6 |
| Chile Telephone .. .. .. | 8 | 8 | 7½ | — | 5 6 8 |
| Cuba Sub. Ord. .. .. .. | 7 | 7 | 10½ | — | *6 13 4 |
| Eastern Extension .. .. .. | 8 | 8 | 15⅛ | — | *5 8 3 |
| Eastern Tel. Ord. .. .. .. | 8 | 8 | 157½ | — | *5 1 7 |
| Globe Tel. and T. Ord. .. .. | 7 | 7 | 14½ | — | *4 16 5 |
| do. do. Pref. .. .. | 6 | 6 | 10½ | — | 5 14 3 |
| Great Northern Tel. .. .. | 24 | 22 | 33 | — ½ | 6 13 4 |
| Indo-European .. .. .. | 13 | 13 | 58½ | — | 5 11 0 |
| Marconi .. .. .. .. | 15 | 20 | 4⅞xd | + ⅛ | 4 4 2 |
| Oriental Telephone Ord. .. .. | 10 | 10 | 2½ | — | 4 9 0 |
| United R. Plate Tel. .. .. | 8 | 8 | 7⅛ | — | *5 1 7 |
| West India and Panama .. .. | 6d. | 1/3 | 1⅛ | — | *3 12 6 |
| Western Telegraph .. .. | 8 | 8 | 16½ | + ½ | *4 17 0 |

HOME RAILS.

| | | | | | |
|---|---|---|---|---|---|
| Central London Ord. Assented .. | 4 | 4 | 65½ | — | 6 2 2 |
| Metropolitan .. .. .. | | 1 | 31½ | +1 | 3 5 6 |
| do. District .. | Nil | Nil | 26 | — | Nil |
| Underground Electric Ordinary.. | Nil | Nil | 8⅜ | — | Nil |
| do. do. "A" .. | Nil | Nil | 8/6 | —3d. | Nil |
| do. do. Income .. | 6 | 4 | 92½ | +1½ | *4 6 6 |

FOREIGN TRAMS, &c.

| | | | | | |
|---|---|---|---|---|---|
| Adelaide Sup. 6 per cent. Pref. .. | 6 | 6 | 47 | — | 6 6 4 |
| Anglo-Arg. Trams. First Pref. .. | 5½ | 5½ | 4⅛ | — | — |
| do. do. 2nd Pref. .. | 5½ | — | 5½ | + ⅛ | — |
| do. do. 5 Deb... | 5 | 5 | 74½ | —1 | 6 14 3 |
| Brazil Tractions .. .. .. | — | — | 57 | +1 | — |
| Bombay Electric Pref. .. .. | 6 | 6 | 102 | — | 5 11 7 |
| British Columbia Elec. Rly. Pfce. | 5 | 5 | 67½ | — | 7 11 5 |
| do. do. Preferred | Nil | Nil | 50 | —2½ | Nil |
| do. do. Deferred | Nil | Nil | 45 | —1½ | Nil |
| do. do. Deb. .. | 4½ | 4½ | 62 | — | 6 17 3 |
| Mexico Trams 5 per cent. Bonds.. | Nil | Nil | 67 | — | Nil |
| do. 6 per cent. Bonds.. | Nil | Nil | 53½ | —2½ | Nil |
| Mexican Light Common .. .. | Nil | Nil | 38 | — | Nil |
| do. Pref. .. .. | Nil | Nil | 49 | — | Nil |
| do. 1st Bonds.. .. | Nil | Nil | 70 | —1 | — |

MANUFACTURING COMPANIES.

| | | | | | |
|---|---|---|---|---|---|
| Babcock & Wilcox .. .. | 15 | 15 | 3⅛ | — ⅛ | 4 1 4 |
| British Aluminium Ord. .. .. | 10 | 10 | 1⅛ | + ⅛ | 8 8 1 |
| British Insulated Ord. .. .. | 20 | 20 | 2½ | — | 4 9 0 |
| British Westinghouse Pref. .. | 7½ | 7½ | 2½ | — ½ | 6 0 0 |
| Callenders .. .. .. | 20 | 25 | 10½ | — | 5 19 1 |
| do. 5 Pref. .. .. .. | 5 | 5 | 3¾xd | — | 5 2 4 |
| Castner-Kellner .. .. .. | 22 | 20 | 3¾xd | — | 8 18 6 |
| Edison-Swan, "A" .. .. | — | — | 1 | + ⅛ | 7 10 0 |
| do. do. 4 per cent. Deb. .. | 4 | 4 | 74¾xd | — | 5 6 0 |
| Electric Construction .. .. | 7½ | 10 | 1½ | — | 8 0 0 |
| Gen. Elec. Pref. .. .. .. | 6 | 8 | 10¾xd | — | 6 5 4 |
| do. Ord. .. .. .. | 10 | 10 | 17½ | — | *5 12 8 |
| Henley .. .. .. .. .. | 25 | 25 | 2½ | — | 6 11 2 |
| do. 4½ Pref.. .. .. .. | 4½ | 4½ | 4 | — | 5 12 6 |
| India-Rubber .. .. .. .. | 10 | 10 | 17xd | — | *5 17 8 |
| Telegraph Con. .. .. .. | 20 | 20 | 48 | — | *5 0 0 |

*Dividends paid free of Income Tax.

## MARKET QUOTATIONS.

IT should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

### Wednesday, January 1st.

| CHEMICALS, &c. | | Latest Price. | Fortnight's Inc. or Dec. |
|---|---|---|---|
| a Acid, Oxalic .. .. .. .. | per lb. | 1/6 | .. |
| a Ammoniac Sal .. .. .. .. | per ton | £80 | .. |
| a Ammonia, Muriate (large crystal) | " | £77 | .. |
| a Bisulphide of Carbon .. .. | " | .. | .. |
| a Borax .. .. .. .. .. | " | £48 | .. |
| a Copper Sulphate .. .. .. | " | £40 | .. |
| a Potash, Chlorate .. .. .. | per lb. | 2/1 | .. |
| a " Perchlorate .. .. .. | " | 1/9 | .. |
| a Shellac .. .. .. .. | per cwt. | £17 10/- | .. |
| a Sulphate of Magnesia .. .. | per ton | £15 | .. |
| a Sulphur, Sublimed Flowers .. | " | £34 | .. |
| a " Lump .. .. .. | " | £26 | .. |
| a Soda, Chlorate .. .. .. | per lb. | 1/1 | .. |
| a " Crystals .. .. .. | per ton | 17/- | .. |
| a Sodium Bichromate, casks .. | per lb. | .. | .. |
| **METALS, &c.** | | | |
| c Brass (rolled metal 9" to 12" basis) | per lb. | .. | .. |
| c " Tubes (solid drawn) | " | .. | .. |
| c " Wire, basis | " | .. | .. |
| c Copper Tubes (solid drawn) | " | 1/7½ | .. |
| g " Bars (best selected) .. | per ton | £150 | .. |
| g " Sheet .. .. .. | " | £150 | .. |
| g " Rod .. .. .. .. | " | £150 | .. |
| d " (Electrolytic) Bars .. | " | £121 | £3 dec. |
| d " " Sheets | " | £161 | .. |
| d " " Wire Rods | " | £132 | £3 dec. |
| d " " H.C. Wire | per lb. | 1/0½ | ½d. dec. |
| f Ebonite Rod .. .. .. .. | " | 3/- | .. |
| f " Sheet .. .. .. .. | " | 3/6 | .. |
| n German Silver Wire .. .. | " | 2/6 | .. |
| A Gutta-percha, fine .. .. .. | " | 11/- | .. |
| A India-rubber, Para fine .. .. | " | 2/7½ | ½d. dec. |
| i Iron Pig (Cleveland warrants) .. | per ton | Nom. | .. |
| l " Wire, galv. No. 8, P.O. qual. | " | £37 | .. |
| g Lead, English Pig .. .. .. | " | .. | .. |
| g Mercury .. .. .. .. | per bot. | Nom. | .. |
| e Mica (in original cases) small .. | per lb. | 9d. to 4/6 | .. |
| e " " " medium | " | 5/- to 10/- | .. |
| e " " " large .. | " | 12/6 to 25/- & up. | .. |
| d Silicium Bronze Wire .. .. | per lb. | 1/8 | .. |
| r Steel, Magnet, in bars .. .. | per ton | .. | .. |
| g Tin, Block (English) .. .. | " | .. | .. |
| n " Wire, Nos. 1 to 18 .. .. | per lb. | 4/6 | 3d. dec. |

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
A Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd
n P. Ormiston & Sons.
r W. F. Dennis & Co.

**Something in the Stew.**—Messrs. Johnson & Phillips, Ltd., the well-known cable manufacturers, have received from one of their business friends in the North an extract from a letter from "Somewhere in France":—

"Food, also, is nothing to growl about, even though you do find something in your jam tin full of stew, which turns out to be a piece of Johnson & Phillips's cab tire sheathing. Our cook is a good advertiser; he said, in reply to our query, 'Nothing but the best goes into *my* stew.'"

In passing us this communication, Messrs. J. & P. remark that they have heard of many of their manufactures being used for other than their legitimate purposes, but they think this is the first occasion on which anything they produce has been utilised as an ingredient for stew. Such is the penalty of quality—the toughness of the material in question was evidently an irresistible temptation to the Army cook, who naturally despaired of ever finding meat to match it.

**British Scientific Products.**—In accordance with the plan previously announced in our pages, the Exhibition of British Scientific Products, which was so successfully held in London last autumn, has been taken *en bloc* to Manchester, where it is housed in the College of Technology. This proceeding has been made possible by the public-spirited action of a number of Manchester business men, who have contributed to a guarantee fund. The Exhibition was opened on December 27th, and will remain open till January 9th. The exhibits, for the most part, are identical with those shown in London, which were reviewed in our columns at the time.

**An E.T.U. Dispute.**—A dispute is in progress in the North Lincolnshire ironstone area between employers and members of the Electrical Trades Union. It appears that 160 men "downed tools" last Friday, affecting, it is said, about 6,000 workers, because the employers would not agree to certain demands without arbitration. The demands were for an increase from 9½d. to 1s. per hour, together with all awards granted by the Ministry of Munitions and the Committee on Production. One report states that the employers offered a concession which would bring the men concerned into line with Sheffield rates, which are fully equal to rates paid in iron and steel works throughout the country.

# CARBON BRUSHES: CONSIDERED IN RELATION TO THE DESIGN AND OPERATION OF ELECTRICAL MACHINERY.

BY P. HUNTER-BROWN, A.M.I.E.E.

*(Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

*(Concluded from Vol. 83, page 640.)*

*Selection of Grade.*—The available grades of brushes may be divided into four classes: graphite, carbon, electro-graphitic and copper-graphite. The first mentioned consist of practically all natural graphite and are distinguished by their very high electrical and thermal conductivity and low co-efficient of friction. Their sphere of use is primarily on high-speed commutators and on slip-rings if the current density and radiating surface permit.

The carbon grades may contain a considerable proportion of graphite at one end of the series, diminishing to no graphite at all at the other end. Generally speaking, they have a higher contact drop than graphite brushes.

The electro-graphitic brushes are made from carbon which after kilning is converted (including the binding material) into artificial graphite in the electric furnace. The characteristics of the material are radically changed by this treatment. The electrical and thermal conductivities are greatly increased, and the material becomes softer, yet can be made very tough. It also becomes very much more refractory; such brushes are therefore specially useful where circulating currents are excessive or overloads severe; this class is largely used for traction work. Heavy circulating currents can be controlled to a certain extent by using a high-resistance brush, but it not infrequently happens that the surface of the brush is eaten away by the action of such currents, and it is then necessary to employ a highly refractory brush. The copper-graphite brushes contain copper, with or without other metals, and graphite to the extent of from 5 to 60 per cent. This series of brushes is required for slip-ring work and to a certain extent for low-voltage plating and similar dynamos. It is characterised by its low-contact drop and high-carrying capacity.

The most important property of a brush is its current-carrying capacity. The actual current in a brush is usually very different from the nominal owing to the large number of disturbing influences. In the case of carbon brushes in parallel, the two parallel parts each consists of contact, brush material, connection of brush to flexible, flexible and terminal connection. The contact resistance is normally greater than the sum of the other four components, and the contact drop is by no means proportional to the current. A roughness on the commutator, a little dust under a brush, or some similar cause might easily raise the contact-drop curve of an individual brush sufficiently to cause it to take only half as much current as its neighbour.

Another fruitful cause of unequal load distribution is unequal pressure applied to the brushes. Fig. 2 (Vol. 83, p. 639) gives a curve of contact drop plotted against pressure applied to the brush. The same positive brush as was used in that test was also tested for contact drop at various current densities, first at 1½ lb. per sq. in. and then at 5 lb. per sq. in. The resulting curves are drawn in full lines in fig. 4.

In the case of two sets of brushes, say 2 in. long × 1 sq. in. section operating in parallel, the total drop in the terminal, flexible connection and material at 40 amps. per sq. in. would be about 0.2 volt, and would vary directly as the current. The broken line curves in fig. 4 include this extra drop, and thus show the total brush drop at 1½ and 5 lb. per sq. in. respectively. If the two brushes were nominally working at 40 amps. per sq. in. it is evident from the curves that the total current of 80 amps. would be divided between the two brushes in the proportion of 24 to 56. It is not uncommon in practice to meet with variations of pressure as great as 1½ to 5 lb. on the same machine. The different brushes on one spindle or on one slip-ring may share the load very unequally, and with a wave-wound armature for the same reason there may be very unequal distribution of load between spindles of the same polarity.

In practice we do not get ideal straight-line commutation, with the result that the distribution of current across the face of the brush is very unequal, in fact, very often an actual reversal of current occurs, current flowing into the brush at one part and out at another.

The carrying capacity of a brush is determined by its permissible temperature rise. The loss in the brush does not depend solely upon the nominal current, and the facilities for dissipating the heat generated are very indeterminate. Any figures given in brush manufacturers' schedules can only afford an approximate guide, and their chief value is relative. Indeed, the latter may be said of all brush data, since the brush itself is only one of many factors entering into the problem.

In the case of turbo-alternator rings the peripheral speed sometimes appears to be unnecessarily high. The diameter of the rings is sometimes made larger than the shaft demands, and there is certainly no need to push out the diameter in order to obtain sufficient radiating surface to dissipate the heat. To meet the altered conditions introduced by turbo machinery it has been necessary to develop new grades of brushes. The characteristics required are a low coefficient of friction, high carrying capacity, and absence of abrasiveness, also preferably low inertia as well. This restricts the selection to brushes in the graphite class.

Built-up mica precludes the possibility of a hard spot extending right through the sheet, and in this respect it is to be preferred to the pure sheet. On the other hand, excess of the adhesive used may lead to trouble. On high-speed commutators (and be it noted the majority of brush problems are concerned with such) the mica is invariably recessed.

In the case of slip-rings, the composition of the material used has an important bearing upon the behaviour of the brushes. Many mixings have been tried, and doubtless there is little to choose between several, but it may be mentioned that Admiralty gunmetal (88 per cent. copper, 2 per cent. zinc, 10 per cent. tin) has been found excellent in every way. Steel and malleable iron possess marked disadvantages. Their thermal conductivity is lower, and even when clean the contact drop with iron or steel is some 30 per cent. greater than with bronze. Also "flats" are very apt to develop.

If the current to be collected is large, low contact drop becomes of special importance, and a highly metallic grade must be chosen. If the current is comparatively small, and the ring surface relatively liberal, it is frequently advantageous to use a pure graphite brush.

Laboratory tests are of great assistance, especially when studied in relation to the performance of the grade under actual operating conditions. With the help of the necessary

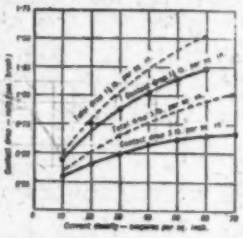


FIG. 4.—CONTACT DROP OF CARBON BRUSH CONTAINING NO GRAPHITE. SPEED 3,500 FT. PER MIN.

data relating to a machine, it is usually possible to select a suitable grade; however, similarly machines exhibit curiously marked idiosyncrasies and demand brushes to suit their individual tastes. The ultimate test as to suitability must be made on the machine itself.

*Operation.*—The tendency to chatter is reduced by tilting the brush either against or in the direction of rotation. There appears to be no universally best angle for the brush. Experiments have shown, however, that if the brushes are set trailing, the angle from the radial may advantageously be from 5 to 15 deg., whereas if the brushes are set reaction, it should be considerably larger, say from 20 to 35 deg. When the angle approaches the maximum it is advisable to round off the sharp edge of the brush to prevent it from digging into the edge of the approaching segments. The holders should be set as close as possible to the commutator, say ¼ in. therefrom. This affords a valuable means of cooling the tip of the brush.

Bedding in an operation that is frequently carried out in a most slipshod manner. The work should be finished with fine carborundum cloth pulled across the face of the brush in the direction of rotation. After bedding, all dust should be carefully removed. The machine should then be run on "no load" for some time, and the current gradually increased so that it is not out of all proportion to the amount of the contact between brush and collector. The pressure should be as uniform as possible, and a suitable spring balance should be used for definitely measuring this. The two primary difficulties in operating brushes are to maintain intimate contact between brush and collector and to ensure a reasonably equal distribution of current between the various brushes. Fig. 2 (Vol. 83, p. 639) shows that to prevent the latter trouble arising the pressure must be made uniform throughout. The actual value should be the minimum required to maintain efficient contact between brush and collector. This will vary from 1½ lb. in a well-balanced turbo-dynamo to about 2 lb. in an ordinary industrial motor; whilst in a traction motor subject to severe vibration the pressure required may be as much as 6 lb. per sq. in., or even more. To prevent the formation of ridges on the commutator the brushes should be staggered. The correct method of doing this is explained in the lower portion of fig. 5.

It is highly inadvisable to mix different grades indiscriminately on the same machine. Occasionally with difficult commutating machines or with very low-voltage dynamos it may prove advisable to mount brushes of one quality in all the positive holders, and of another quality in all the negative holders. Also, in the case of slip-rings a few graphite brushes are sometimes mounted on the same ring with metallic brushes; the sole function of the graphite

brushes is to lubricate the ring. Owing to their contact drop being so much higher than that of the metallic brushes they will carry no current whatever, and therefore incidentally there is no need to fit such brushes with flexibles.

The rate of wear of the collector is dependent upon the material it is made of, the quality of the brush, current density, and the intimacy of contact between the brush and collector. If the brush is too abrasive, obviously it will cause excessive mechanical abrasion. On the other hand, if it is insufficiently abrasive to keep the mica flush, copper picking is very likely to result, proud mica being one of the most fruitful causes of this troublesome malady. It is difficult to explain all the phenomena associated with copper picking, but, that it is due to something akin to electrolytic action is clear from a consideration of the following:—

If a commutator is equipped with brushes arranged so that the positives and negatives sweep different tracks, and if the machine is run with no current, the two halves of the commutator will maintain the same appearance, and the wear caused by abrasion will be relatively very slight. If then current is passed through the armature the portion of the commutator under the positive brushes (speaking in a motor sense) will assume a dark polished appearance, as though carbon or graphite from the brushes passed in the direction of the current and were deposited on the surface of the copper. The portion of the commutator under the negative brushes will retain a bright coppery colour and become more or less raw in appearance. The rate of wear under the negative brushes will be very much increased compared with that observed when no current is flowing, perhaps by several hundred per cent., showing that, due to the action of the current, particles of copper are passing away from the surface of the commutator in the direction of the current flow. The minute particles of copper passing in the same direction as the current usually do not adhere to the

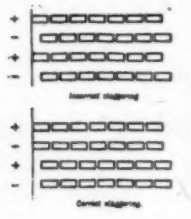


FIG. 5.—METHODS OF STAGGERING BRUSHES.

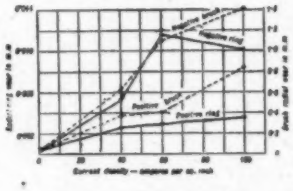


FIG. 6.—WEAR OF SLIP-RING AND BRUSH. PRESSURE 4 LB. PER SQ. IN.

face of the brush, but sometimes they are firmly deposited on the contact surface as though the latter had been copper plated. It is difficult to determine exactly the conditions under which copper will be deposited on the brushes. Undoubtedly the action is promoted by lack of perfect contact between brush and commutator, and it increases with the current density. Poor contact may result from insufficient pressure, chattering, or more frequently from high mica. If in addition to poor contact between brush and copper the current density is high, the conditions are favourable for deposition of copper on the brush, and when once the first speck is deposited the process becomes cumulative.

When brushes are staggered to prevent the formation of ridges on the commutator this should be done so that each track is still swept by an equal number of positive and negative brushes. Fig. 5 shows the incorrect and also correct methods of staggering brushes.

The presence of circulating currents appears to account for the fact that positive as well as negative brushes are liable to become copper coated as circulating currents pass into each brush as well as out of it; it is probable that if it were not for the circulating currents the current density in the brushes would seldom be high enough to bring about the conditions necessary for the deposition of copper.

Where persistent copper picking occurs an improvement may be effected by a change in the quality of the brush on lines suggested by the above; but in general the "electrolytic" action should be reduced to a minimum by ensuring good contact between brush and commutator, and by avoiding excessive current density, whether caused by the working current or by circulating currents. The problem is closely connected with the design of the brush holder, the quality of the mica, the shape of the pole tips, and the various other factors determining the extent of the circulating currents, as well as the density in the brushes due to the working current.

In addition to the electrolytic action described, a certain burning action occurs, even when there is no visible sparking. This is dependent upon the intimacy of contact and current density, and affects both positive and negative. There is a very close connection between the current density and the life of both brush and collector. Fig. 6 shows the relative amounts of wear produced at various current densities by an ordinary carbon brush. The tests were made on bronze slip-rings. The process rapidly becomes cumulative. That excessive commutator wear may be caused by the brushes being insufficiently abrasive to keep the mica flush has been proved repeatedly by overcoming such wear by deliberately replacing the brushes by another quality of a more abrasive character. The wiser course to adopt with large machines, and the absolutely necessary course in the case of very high speeds, is to recess the mica. When this is undertaken, however, the work must be very well carried out or the results will be worse than before. The depth of the groove should not be greater than the thickness of the mica, and the latter should be cleanly removed so as to leave a groove rectangular in section. The edges of the segments should then be very slightly bevelled. The slots should be regularly cleaned out.

When the mica is well recessed a high-grade non-abrasive graphitic brush may be used, and the wear of both commutator and brush is reduced to a minimum.

The rate of wear of the brush also is very largely affected by the current density. In fig. 6 curves relating to pure carbon brushes are given which show how very marked this influence may be.

Modern high-grade graphitic brushes are practically self-lubricating, and wherever possible it is advisable to abstain from applying lubricant to the commutator. Frequently the conditions are rendered unnecessarily difficult through a lack of appreciation of the factors essential to successful operation on the part of the attendant rather than from mere wanton neglect.

Close attention to what may appear trivial mechanical details should be emphasised, for experience shows that it is not as generally recognised as it should be how much the life of both brushes and collector may be increased and the general performance improved in this way.

Commutators are never mathematically circular and a very small mechanical defect is sufficient to cause a momentary separation between the brush and the collector. It is of vital importance that the brush should be free to follow up any slight irregularities. Close attention to the condition of the brushes and brush gear leads not only to a saving in time, but also to a marked reduction in maintenance costs.

*Standardisation.*—Designers in America are of the opinion that very considerable latitude must be left to them in the selection of brush dimensions. The dimensions of the actual block, however, are only the beginning of the problem. There is the question of fittings to be considered. If brushes are really to be standardised as regards their mechanical design a certain degree of uniformity in the design of holders becomes necessary, so as to permit uniformity in the length and position of flexible, and also in the type and size of terminal. When it comes to a question of quality this would appear to defy all efforts at standardisation, except possibly on exceedingly broad lines. Even standardisation of machine design would not completely eliminate the difficulties here, since the differences in brush properties are so subtle and yet so pronounced in their influence on the behaviour of a machine that it seems fundamentally impossible to harness them in a specification.

A certain measure of standardisation is possible within prescribed limits. Any recommendations that could be applicable to all types of machines, however, must necessarily be on such very broad lines that they could scarcely be described as standardisation. It is therefore wise to proceed by stages, including at first only the mechanical design of the brush and applicable only to machines intended for a certain class of work, such as motors and generators (excluding turbo dynamos) for shipboard use. This is the sphere in which the benefits of standardisation would naturally make themselves most felt, and by proceeding cautiously in this way it may in time prove practicable to introduce recommendations of a more comprehensive character.

## FINANCIAL FACILITIES FOR TRADE.

THE Committee on the Provision of Financial Facilities for Trade After the War was appointed jointly by the Chancellor of the Exchequer and the Minister of Reconstruction in November, 1917, under the chairmanship of Sir Richard B. Vassar-Smith, of Lloyd's Bank. They introduce their Report (now published by the Ministry of Reconstruction) by expressing the emphatic opinion that the primary factor in repairing the wastage of capital caused by the war lies mainly in increased production and actual saving.

Discussing the financial requirements of industry after the war the Committee foresee:—

(*a*) A considerably more than normal demand for working capital owing to the higher cost of labour and materials, the necessity for giving longer credit, and the anticipated expansion in the volume of trade due to the fact that the basis for potential commercial output, as compared with pre-war output, has been very greatly enlarged during the war by the extension of existing works and the building of a very large number of absolutely new ones.

(*b*) A greater than normal demand for extended credits for the purpose of replacing at higher cost machinery and plant which has fallen into disrepair.

(*c*) Demands in connection with the reconversion of plant and works. These in many cases may be on the border line between working credit facilities and new capital requirements.

(*d*) New fixed capital requirements for extensions or new works.

The Committee point out that the ability of industry to cope with these unusual financial problems during the reconstruction period will be most limited in the case of entirely new firms which have come into existence owing to the demand for war material. They have been urged strongly that it was not in the national interest to allow these firms to peter out, and that every inducement should be given them to continue in business even to the extent, if necessary, of granting State financial assistance. The Committee express the opinion that it might be regarded as unjust to enable such firms by means of State aid to compete with old-established firms in the same industries, and also that it would be very difficult, if not impossible, to guard against wastefulness and inefficient management. The solution in these cases appears to them to lie in the establishment of new industries, the capital for which should be furnished by the investor or by the individual partners in the business. The ability to attract the necessary capital will depend upon the inherent soundness of the proposition in each case.

The Committee further point out that it would be of great assistance to manufacturers in making plans for the future if the future policy of the Government were made known as early as possible in regard to:—(*a*) Fiscal policy, (*b*) rationing of raw materials, (*c*) the break clause in connection with the termination of munition contracts, (*d*) the disposal of national factories and surplus stores.

Before discussing means of providing credit facilities after the war, the Committee give a short explanation of our credit system as existing before the war.

In normal times the amount of credit varies with the amount of gold, the necessity for keeping the gold standard effective acting as an automatic check upon the expansion of credit. As the balance of indebtedness of this country with foreign countries became unfavourable, and the exchanges in consequence moved against us, it became profitable to export gold to pay debts abroad. The consequent shrinkage in the amount of gold in the country, and the reduction in the Bank of England ratio of reserve to liabilities necessitated a rise in the Bank rate, which in its turn brought about a general rise in rates of interest. This rise in interest rates had a twofold effect. It attracted gold to this country, and induced gold, which would otherwise have been exported, to remain; secondly, it induced people to pay off loans, and discouraged the raising of new ones. If the drain of gold was severe enough to make money "tight," it became difficult to renew existing loans, and this caused the sale of goods and produce upon which the loans were secured, so bringing about a fall in prices, which encouraged exports and discouraged imports, so that the situation was gradually adjusted.

Further, from the point of view of purely internal trade, the fact that gold was the only legal tender was equally effective in preventing an undue expansion in credit, banks being obliged to maintain a proper relation between the extension of credit facilities and their available supply of gold. Thus the gold standard acted as a wholesome restraint upon over-trading, and often adjusted situations which, unchecked, might have developed into a severe commercial crisis.

The position to-day is entirely different. As there is no free international market in gold, the operation of the foreign exchanges has been interrupted, while at the same time the internal gold circulation has been replaced by a currency note issue. As there is no legal limit to the amount of currency notes which may be issued, there is therefore no automatic check upon the expansion of credit. The very large extent to which expansion has taken place is shown by the fact that whereas the total deposits at the banks of the United Kingdom, exclusive of the Bank of England, amounted at the end of 1913 to £1,070,000,000, the amount of deposits is now nearly £2,000,000,000. The enormously increasing purchasing power thus created has, in the Committee's opinion, been one of the main factors contributing to the general rise in prices.

In regard to the position after the war, the Committee express the opinion that it is essential for the reconstitution of industry and commerce to impose restrictions as soon as possible upon the creation of additional credit by the restoration of an effective gold standard. To attempt to rebuild industry by the further indiscriminate expansion of credit would endanger our position as the financial centre of the world, and would inevitably lead before long to grave disaster. The Committee accordingly seconded the cessation of State borrowing as early as possible, all available money being required for the financing of commerce and industry. The Committee also consider that any Government guarantee to bankers to enable them to provide by means of credits for fixed capital expenditure for the reconstitution of industry is undesirable, as being likely to occasion a further expansion of credit followed by an additional rise in prices. It is also recommended with a view to the gradual reduction of credit inflation, arising from the enormous volume of short-dated Government debt, that the State should undertake funding operations at an early date for this purpose.

As to banking facilities for carrying on ordinary businesses, the evidence submitted to the Committee led them to the opinion that the situation might safely be left in the hands of the banks. To enable the banks to give facilities for extended credit it is recommended that every facility should be given by the Government to enable the banks to issue any new share capital which may be found necessary to strengthen their position. It is thought that the rationing of available supplies of raw materials will provide a valuable guide to the banks in selecting the directions in which loans will be best secured and are most urgently required.

The policy of trade organisation which is now in evidence is welcomed by the Committee as furnishing a sound basis for the granting of credit facilities to industry. They also believe that if a portion of the new issues of shares which will be necessary for many manufacturing establishments, in the form of preference shares giving a good return in dividends, were reserved for the workpeople in these establishments, it would materially assist both financially and in other equally important directions.

The Committee consider that the continuance of some measure of State control over new issues is desirable for a certain period, and that, with a view to the further prevention of unsound promotions, the Companies Acts might be strengthened. The enormous potential increase in the number of small investors, as shown by the figures published by the National War Savings Committee, and the importance of the encouragement of this tendency for the rapid reconversion of trade and industry, are emphasised by the Committee, as is also the necessity for genuine saving to make good the destruction of capital during the war.

In regard to State aid, while the Committee do not recommend the guaranteeing of banks by the Government or the investment of public money in loans to persons who have been unable to obtain them from other quarters, it is considered that cases of hardship may arise in connection with firms who have undertaken, under considerable pressure from the Government, the manufacture of munitions of war. To meet such cases the Committee suggest the establishment of a small committee of Government officials and business men in leading industries to consider claims of this kind in the first instance, or to act as a tribunal to which applicants can make appeal. The Committee are also of opinion that it would be of very great assistance to manufacturers and others, who had been prevented from forming adequate reserves by the present high rate of Excess Profits Duty, if arrangements could be made by which a proportion of the tax would be retained for a period as a loan upon terms likely to secure early repayment.

## NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

***Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.***

### A Novel Lighting Fitting.

Mr. R. W. FLETCHER describes in the *Transactions* of the South African Institute of Electrical Engineers a novel lighting fitting which he has found to be very satisfactory for special positions. As will be seen from the sketch, fig. 1, the principal features of the fitting are high insulation of the lampholder, ease with which a holder can be replaced, and freedom from vibration. The holder is carried on a fibre

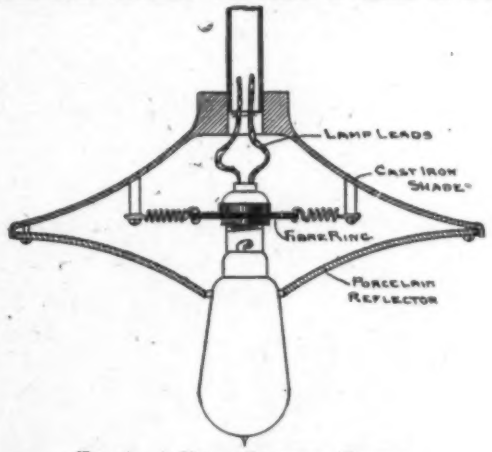



FIG. 1.—A NOVEL LIGHTING FITTING.

ring, so that any ordinary holder that has a shade ring can be used, and the insulation is much higher than is the case with insulated bushings. Another point is that the leads to the holder can be left slack, and a new holder can be fixed without any difficulty; anyone who has tried to fix a new holder on to a fitting with a nipple where enough slack wire cannot be got down the pipe will appreciate this feature. The spring suspension of the holder prevents loss of lamps through their falling out of the holder, and is also a valuable

feature in the case of half-watt lamps. The fuse-box attached to this fitting consists of a round cast-iron watertight box fitted with Dorman & Smith's thumb fuses, the leads being arranged to enter at the bottom through bushings, and leave through the top. Ample space is allowed so that a fuse can be replaced without burning the fingers or short-circuiting with the sides of the box.

### An Automatic Lamp Reel.

An automatic extension reel for electric lamps designed to be used in factories is shown in the accompanying illustration, fig. 2, which is taken from *Industrial Management*. The reel itself is 9 in. in diameter by 2 in. in width, and is provided with 25 ft. of reinforced cord. The support for the reel is provided with a swivel joint permitting the cord to lead off in any direction. It is provided with an automatic lock so that any position of the reel and any amount of unwound cord may be held. The automatic lock catches and

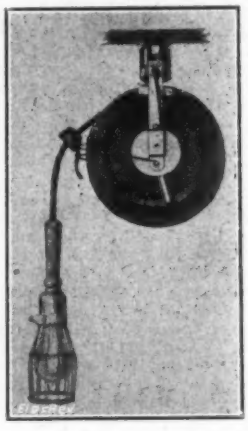


Fig. 2.—Automatic Lamp Reel.

holds the cord through a slow backward movement after it has been unwound to the desired length. To rewind, it is merely necessary to give the cord a slight pull, which unlocks the catch, and the reel then automatically rewinds the cord as the person holding the lamp walks towards the reel holding the lamp in his hand. This device is manufactured by the Cincinnati Specialty Manufacturing Co., Inc., Cincinnati, Ohio.

### An Electrically Heated Crucible.

The accompanying diagram, fig. 3, shows a melting plant adapted for use with a patent electrically-heated crucible of 150-lb. capacity brass, with special pouring spout. The crucible itself serves as the resistor through which the electric current is passed, and is so designed that the maximum heating effect is produced in the zone where actually required.

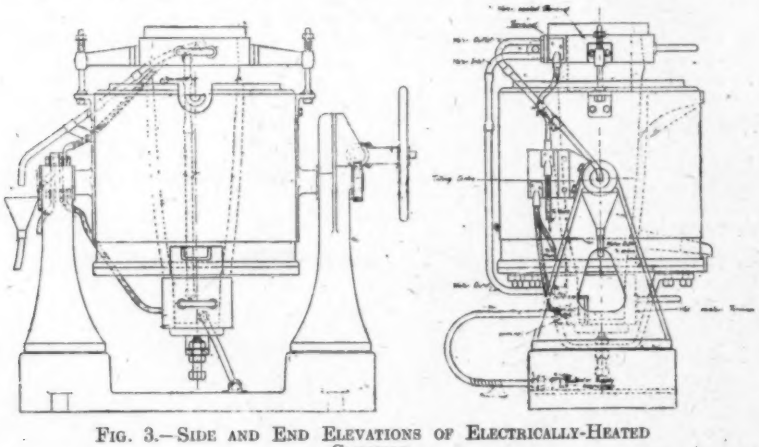


Fig. 3.—Side and End Elevations of Electrically-Heated Crucible.

The plant shown, by the Morgan Crucible Co., Ltd., Battersea Works, Church Road, London, S.W., is arranged for use with continuous current, but can be arranged for single-phase or for one phase of a three-phase circuit. The current taken is approximately 1,000 amps., and the voltage approximately 20 to 40 volts. The plant is arranged to tilt about the centre. Any of the well-known means of regulating the electric supply can be used. The body is constructed of a cylindrical steel casing bolted to cast-iron top and bottom rings, supported on centre trunnions, to one of which is fitted a worm-wheel engaged with a worm, and the tilting gear is operated by means of the hand-wheel.

The patent water-cooled terminals which make contact direct with extensions to the top and the base of the crucible are of gunmetal, machined on the inside, and made in halves hinged together, and provided with tightening bolts to ensure perfect contact.

The bottom water-cooled terminal is supported by a cone-pointed pin fixed vertically in the centre of a sling hanger carried from the bottom plate. By this means any variation which might possibly occur in the vertical alignment of the crucible is automatically adjusted. The top water-cooled terminal is maintained central and steady by means of two arms, bored and fitted with steadying spiral springs, which slide on vertical guide-rods with adjusting nuts attached to the plant. The arms are insulated from the terminal.

A slate or hard-timber terminal board is rigidly fixed to one of the standards, and is fitted with thimbles for taking the cables. Suitable flexible leads connecting the board to the water-cooled terminals are supplied with the plant. A similar arrangement is provided for the water-cooling pipes. The top extension of the crucible forms a convenient charging hopper for metal, and is provided with a special refractory cover. A drain spout is fixed at the front of the plant as a safety outlet for the metal should a crucible fail.

The interior of the plant comprises a thickness of insulating material entirely covering the steel casing, and a Battersea triangle ( △ ) brand refractory sectional lining. The small space between the lining and the crucible is filled with suitable refractory and non-conducting material.

The heat efficiency of the electric crucible being high, the cost of power is correspondingly low, whilst the ease of handling, cleanliness of operation, and the accurate regulation of the temperature, and consequently the good quality of metal obtained, are outstanding features of merit. The company has several designs of crucibles still under consideration, but the broad principle in all of them is shown by the above diagrams. The company has also successfully produced tubes which are heated electrically in a similar manner, and can be used for the manufacture of gases of various kinds, for the reduction of oxides, and for many other metallurgical purposes.

## ELECTROLYTIC PROCESSES.

All of the metals which are derived to-day in commercial quantity from their fused salts by electrolysis are those exceptionally electropositive metals, which either cannot be obtained at all in appreciable yields by strictly chemical means, or can be obtained thus only with great difficulty and at great expense. The following particulars are taken from the *General Electric Review* for November, which contains interesting articles on this subject.

*Sodium.*—Sodium is obtained at the cathode by the electrolysis of either fused caustic soda (NaOH) or of fused common salt (NaCl). The former is of advantage because of its much lower melting point, and because the escape of the gas freed at the anode does not have to be considered. Chlorine gas, on the other hand, cannot be allowed to escape promiscuously, and so must be used to make bleach, or collected for government purposes. The Castner process, which employs NaOH, is the best known, and is operated in America at Niagara Falls by the Electrochemical Co.

The principal details of the Castner cell are shown in fig. 1, p. 27. The current enters through the iron anode which surrounds the top of the vertical iron cathode. This cathode extends up through the bottom of the cell, passing through a cast-iron pipe or collar which is attached to the bottom of the cast-iron box which holds the molten electrolyte. The space between cathode and iron pipe is sealed by filling it up with the melt, which is then allowed to freeze. A fine nickel gauze diaphragm is inserted between anode and cathode to prevent globules of sodium from reaching the anode and reacting with the water vapour formed there. The molten sodium is collected inside of the chamber from which the gauze diaphragm is hung. In practice the charge is kept in a molten state by proper regulation of the current density. Heat radiation is reduced by suitable brick lagging. The electrolysis must be performed at a fairly constant temperature of 315 to 320 deg. C. This is only 15 to 20 deg. C. above the melting point of the caustic soda. Even at 325 deg. C., the yield falls nearly to zero. About 4.5 volts (2.2 volts decomposition voltage) are required per cell, and a direct current of 13 to 17 amps. per sq. in. is used. The current efficiency is probably about 45 per cent. and the energy efficiency about 22 per cent. About 0.56 metric ton per H.P.-year is estimated from the data at hand.

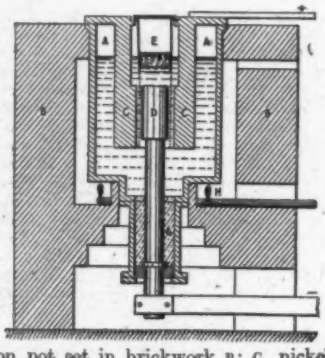
The main cause of the low efficiency is due to the fact that water is formed at the anode, which, if it does not react with

sodium already deposited (which is apt to reach the anode occasionally), is itself decomposed into oxygen and hydrogen to greater or less extent.

Most of the sodium made is used to manufacture sodium cyanide and sodium peroxide. The metal has also been tried for drying transformer oils. About 2,000 tons were made in the United States annually before the war.

*Calcium.*—The cell comprises an iron box with water-cooled bottom, through which projects an insulated conical iron cathode. Inside the box and insulated from it is an annular carbon lining which serves as anode. The temperature of the bath and of the cooling water is so regulated that the iron bottom is covered with a thin protective layer of solidified salt. The deposited metal is drawn in stick form as soon as formed and sufficiently solidified at a speed equal to the rate of deposition. One advantage of this method of removing the deposited metal is the smaller tendency for metal fog to form which sometimes occurs at excessive temperatures and under reducing conditions. Addition of oxidising agents to the bath, or neutral salts in some cases, will destroy the fog. The explanation of the phenomenon is not certain. It consists in the sudden rise from the molten metal (cathode) into the fused electrolyte over the metal of dark clouds whose colour depends upon the nature of the cathode metal. These clouds seem to dissolve in the melt. It is probable that the clouds consist of colloidal suspensions of very finely divided particles of the fused metal. The effect of the fog is to reduce the current efficiency of the process.

The metal is at once obtained in pure, solidified massive form. The electrolyte consists only of fused calcium chloride ($CaCl_2$) held at a temperature of 780 to 800 deg. C. It is estimated that one of these cells may take as much as 25 volts, the decomposition voltage being only 3.24 volts. The very high current density of 650 amperes per sq. in. is used, which would account for the high voltage. Practically 80 per cent. of the potential drop is at the cathode. From this data, assuming a current efficiency of 80 per cent., an energy efficiency of only 10 per cent. is obtained. The yield per H.P.-year is thus only 0.1 metric ton. But little information has been published about the process. The present output per year is small, probably not over 250 lb.




A, cast-iron pot set in brickwork B; C, nickel anode; D, cathode; E, metal cylinder receptacle for sodium; F, liberated sodium.

FIG 1.—CASTNER SODIUM FURNACE.

*Magnesium.*—The metal is marketed in both powder and stick form. For an electrolyte a mixture of fused dehydrated carnollite ($KCl, MgCl_2, 6H_2O$) plus one mol of salt ($NaCl$) is used. During the electrolysis $MgDl_2$ is added, and a certain amount of calcium fluoride ($CaF_2$). The temperature of the melt is probably 750 to 800 deg. C. From laboratory experiments, a current efficiency of 75 per cent. may be assumed. The energy efficiency is probably below 40 per cent. An average of 9 volts per cell is estimated. Available data would indicate a yield of about 0.37 metric ton per KW.-year.

*Aluminium.*—In America the Hall process is used, while in England and on the Continent the somewhat similar Heroult process is worked. The Hall cell consists of a rectangular cast-iron box, lined with carbon which acts as cathode until the bottom is covered with the molten aluminium, which then serves the same purpose. The current is led into each cell through a series of graphite rods which are distributed uniformly in the cell, dipping down into the fused electrolyte almost to the layer of molten aluminium at the bottom. The molten aluminium is removed periodically by tapping. The fused electrolyte consists of cryolite ($AlF_3, 3NaF$), to which enough pure aluminium flouride ($AlF_3$) is added to bring the melt to the formula $AlF_3, 2NaF$ and of pure alumina ($Al_2O_3$). The alumina is the solute and the cryolite the solvent; in the fused melt the alumina is decomposed into aluminium at the cathode and oxygen at the anode. The decomposition voltage of $Al_2O_3$ is less than that of either $NaF$ or $AlF_3$, which explains why it and not its solvent is electrolysed. Alumina has to be continually added to the melt to compensate for that decomposed. The normal current efficiency is supposed to be 90 to 95 per cent., but in many works it is not over 65 per cent. An average efficiency of 75 per cent. is about right. With a voltage drop of 5 to 6 volts per cell (assuming 2.2 volts decomposition voltage), this would bring the energy efficiency to 30 per cent. The yield per H.P.-year amounts to about 0.3 metric ton. Much of the loss is due to metal fog formation, the temperature of the bath being some 900 to 1,000 deg. C., which is maintained by the heating effect of the current, while aluminium melts at about 665 deg. C. The anode losses are high, as the oxygen liberated at the anode reacts with the graphite, forming carbon monoxide before escaping. The anode effect (the anode becomes covered with a film of gas through which the current is able to pass only by the aid of the formation of a great number of minute arcs, which play between electrode and electrolyte) has always to be guarded against by keeping the bath in proper working condition. The principle of the Heroult process is the same as in the Hall process. The cell is circular instead of rectangular, and the individual anodes are of much heavier cross section. Each cell takes about 7,000 amperes at 7 volts.

Figures showing the change in the cost of aluminium are of interest.

| Year. | Price per lb. | Method of Reduction. |
|---|---|---|
| 1855 ... | $90.00 ... | Old chemical (St. Claire Deville) |
| 1886 ... | 12.00 ... | Old chemical (St. Claire Deville) |
| 1889 ... | 4.00 ... | New chemical (Castner) |
| 1889 ... | 2.00 ... | Electrochemical (Hall) |
| 1911 ... | .20 ... | Electrochemical (Hall) |

## CORRESPONDENCE.

***Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.***

### The Purchase of Appointments.

Surely it is an error of judgment on the part of the ELECTRICAL REVIEW that the advertisement under Box 6248 in the current issue was accepted, or have you purposely brought it to light?

If it does not come within the Corrupt Practices Act, such an offer is running very close to it.

To my mind it is a despicable form of bribery, and whilst I cannot imagine anyone entertaining the offer who has the interests of an undertaking at heart, the person who does so for his own interest should ponder well over the advertiser's boast of an "unblemished character."

Is this what we are to expect from these "well known" engineers of the "profession" (*sic*), who by reason of their exceedingly good pay whilst in the safe employ of the Ministry of Munitions have been able to save sufficient to make such offers?

What chance have our *real* engineers still "out there" against corruption of this kind? We look to you, Mr. Editor, to see fair play.

**B. W. Gothard, A.M.I.E.E.**
*Electrical Engineer,*
*Aldershot Gas, Water, & District Lighting Co.*
Electricity Works, Farnborough, *December 23rd*, 1918.

[We entirely agree with our correspondent; such offers as the one he refers to are highly objectionable and contrary to the public interest, besides being unfair to those who are in competition with the advertiser. Unfortunately we were not aware of the insertion of the advertisement until after its publication, but steps will be taken to prevent a recurrence.—EDS. ELEC. REV.]

### The Royal Albert Hall.

Referring to this incident, permit me to amplify slightly the remarks of "Electric Supply" in your issue of 6th inst., and to point out that the action taken was provoked by the attempt of the management to break a contract entered into for the letting of the Hall. It is to be hoped that it may be a useful lesson to those who have been in the habit of suppressing, and who wish to continue to suppress, free speech, free publication, and free assembly. It may also be pointed out that no public inconvenience was sustained by the method adopted to prevent such suppression, as would have been the case by shutting down various electric lighting stations if this had been carried out.

**W. Sisson.**

Gloucester, *December 23rd*, 1918.

### Charging Electric-Truck Batteries.

The article appearing in the ELECTRICAL REVIEW for December 20th describes a very ingenious method which has been adopted for charging an electric-truck battery in the case in which the users of the battery were unable to obtain a small motor-generator set.

The engineer who devised this method, and the automatic gear which is described, is certainly to be congratulated upon the successful and economical solution of his difficulty.

Now that the impossibility of obtaining suitable charging plant has been removed the disadvantages of the method described should be clearly understood before any user who is installing electric trucks decides to copy it.

If the battery is connected directly to the mains, either in series with a motor, or in series with a resistance, it is subjected to the full line pressure to earth; that is to say, in the case of a 440-volt, 3-wire supply the voltage to earth will be 220 volts.

In many cases these electric trucks are fitted with insulated wheels, and in these cases there is a very considerable danger of obtaining a shock from any part of the truck to earth unless an earthing core has been provided on the charging plug. Unfortunately, many of the imported trucks are provided with plugs in which no provision is made for an earthing core. As there is usually slight moisture round the battery there is almost sure to be a leakage to the framework of the truck, and the danger is a very real one.

The recommendations of the Electric Vehicle Association are very strongly in favour of the provision of an earth core on the charging cable, and if this recommendation has been carried out, or if the truck wheels efficiently earth the framework, the danger of shock is eliminated.

A still more serious objection is then, however, met with, as the battery itself will now have to withstand the voltage to earth, and several cases have already occurred in which the leakage over the outsides of the battery while charging has been such as to cause serious damage. The following extracts are taken from correspondence with two of the principal makers of truck batteries when dealing with the question of the use of a method of charging which had the same disadvantages as the method now under discussion:—

(*a*) "The great disadvantage is that the battery must be subject to the full 200 or 250-volt pressure to earth, and this, in our opinion, makes the method quite undesirable. It is not a question of great risk of shock, but the pressure is too high for the walls of the cell containers."

(*b*) "We are afraid that the fact that the battery is subject to 220/250 volts to earth is a decided disadvantage, particularly when it is borne in mind that the outside container of the cell is alive. The method of insulating the cells from earth is only designed to deal with much lower pressures, and we would not take the responsibility of recommending the batteries to stand up regularly to a higher pressure."

It is true that in the case described in the article the mains pressure is only 250 volts, but in the majority of cases the supply is at a higher pressure, and even in the case of a 250-volt supply it is quite usual for one main to occasionally become earthed, in which case the full pressure to earth is available on the other main.

It would appear, therefore, that while the ingenuity of the method described is fully recognised, it should be regarded as a war measure only, and not good practice for use under normal conditions.

**H. W. Bosworth.**

London, *December 24th*, 1918.

### The Electrical Contractor.

On the brink of a boom in electrical installations in private house, factory, or wherever it may be, perhaps a word or two on this subject may be useful to both intending installer and customer.

It has, unfortunately, occurred in very many instances which I have personally become acquainted with, that the first object of the contractor has been either by hook or by crook to book the contract. This over, he has "made good" by employing boys, improvers, or any other cheap labour he could get hold of.

What has resulted? The quality of the installation has suffered in consequence, and the customer has paid dearly in the long run for accepting a cheap tender. Again, it seems quite the usual thing for an intending customer, after being "quoted" for certain work to be done, to give the job to another less conscientious contractor who says he can do the job for so much less.

The customer, not being versed in electrical matters, is not in a position to decide which it will pay him best to accept—the one that is a little dearer in the first place, or the one that becomes a maintenance job indefinitely.

The loopholes for the cheap contractor are: Young cheap labour, inferior cable and material. This kind of thing occurs where a number of contractors are pricing for certain work without a specification drawn up by a practical man. It is the custom at present among customers who have not a lot of money to expend on electrical work to bite at the lowest price—very often to their sorrow.

I am afraid that the coming boom will bring a lot of cheap contractors into the electrical line, and it may be some time before the bad quality of the installation is found out.

It seems a pity that so many rubbishy qualities of electrical material are allowed on our markets to tempt the dishonest contractor—Japanese lampholders, ceiling roses, &c., American cable, and cheap iron conduit are the curse of any decent contractor. Why not establish definite standards which contractors would have to adhere to, and find it impossible to depart from?

There will be sufficient work and to spare in the near future, without dishonest under-cutting, which leaves the customer to pay the piper. The Phœnix Fire Office rules caution the intending customer against accepting the lowest tender without first acquainting himself with the quality of the material and workmanship about to be put in.

My chief reason for writing these short notes is that they may lead to something being done in the matter by the leading contractors to close the door to the "Do-your-job-at-any-price-man," who will otherwise become a menace to consumers of electricity. Let our motto be a "Straight price for a proper job," and the betterment of the electrical profession.

**H. Fowler.**

Liverpool, *December* 29th, 1918.

[The exclusion from the market of inferior materials is one of the objects of the proposed "National Proving House," which is in course of organisation under the ægis of the Institution of Electrical Engineers, with the co-operation of the National Physical Laboratory and other public bodies. The guarantee under penalty of good workmanship and material provided by the Electrical Contractors' Association corresponds to the admirable aims expressed in the last paragraph of Mr. Fowler's letter. Thus something is being done to improve the situation, but we agree that this is only the commencement of the work that is necessary.—EDS. ELEC. REV.]

## ELECTRICAL TRADE BENEVOLENCE: AN APPEAL.

MR. C. E. HUNTER, the chairman of the Electrical Trades Benevolent Institution, is making a special effort on behalf of that organisation and fund, and he asks for the co-operation of the trade. He has issued an appeal in which he states that the invested funds are only £9,000 odd and the total revenue for the past year was only £781. We believe that everybody will agree with him that it is desirable to put the Fund on a better basis, "worthy of the most progressive business in the kingdom." He is eager to mark the period of his office by raising a large sum which will bear some relation to the importance of the electrical trade. Most of our readers are aware that the institution cannot at present pay pensions save out of revenue. That is one very good reason for building up a big invested capital. Another important reason for supplementing the present resources is the increase in the cost of living and the correspondingly decreased value of grants if limited to the pre-war amounts. The present invested capital was collected prior to the war largely at the annual festivals, but during the past four or five years while there has been a period of great activity for most departments of electrical engineering industry, the time has not been convenient for festival dinners or energetic propaganda schemes. Those who ought to be interested in the maintenance of this fund have hardly been able to plead poverty, and we believe there are some who to-day could put the institution in a far more satisfactory position without feeling the pinch. What has probably weighed with some people during the war has been the fact that industrial activity has lessened the immediate demands, but as the circular before us points out, after the overstrain on electrical production engendered by the war, claims on the fund will become heavier, and the resources should now be strengthened to enable them to be ready to meet whatever needs may arise. It is not inconceivable that there may yet be occasion to give some kind of assistance to discharged and disabled men from the Forces. We hope that contributions, large and small, will flow in to Mr. Hunter's offices at 123-125, Queen Victoria Street, London, E.C. 4. It is our intention to publish a list of all the "Hunter" subscriptions and donations in the ELECTRICAL REVIEW.

**Tramway Employes' Working Hours and Conditions.**—Early in the New Year the two Tramway Associations are to discuss with representatives of the National Transport Workers' Federation the following proposals, which have been advanced by the latter organisation, for new working conditions for employés on municipal and company tramways of the United Kingdom:—

That the working week shall consist of 44 hours, inclusive of signing on and signing off.

That every employé shall be guaranteed a working week of 44 hours or payment equivalent thereto.

No day's work shall be in excess of eight hours.

In no circumstances shall a reduction in the working day entail a reduction in existing wages.

No spread-over duty shall exceed nine hours, inclusive of meal times or relief.

All national holidays, Sunday, and overtime labour to be paid for at the rate of time and a half.

All employés shall be granted 14 days' holiday annually, with pay.